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ELLIOTT TURBINES

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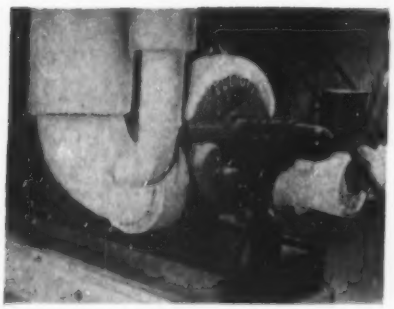
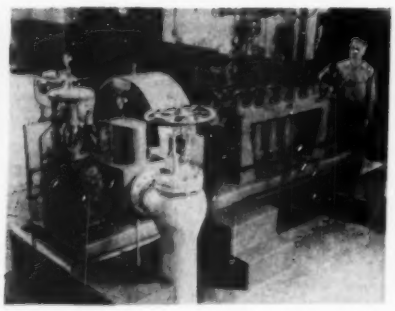
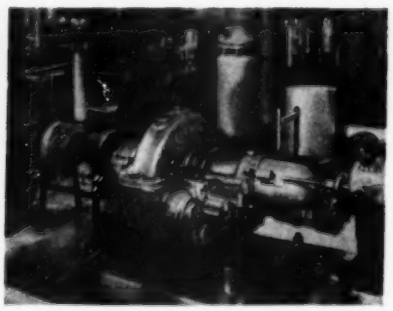


Elliott 360-hp, 3550-rpm turbine driving a boiler-feed pump in a paper mill, exhaust steam being used in process.



Elliott 500-hp turbine driving a hydraulic system pump in a steel mill. Turbine maintains constant pump discharge pressure.



One of a group of Elliott turbines driving lean oil pumps in a cycling plant, where reliability is especially important.

A standard turbine— yet "tailor-made" to your requirements

Elliott Turbines can be adapted to practically any operating condition or service

That's because these powerful, compact turbines are designed to give you the advantages of custom-built adaptability at savings achieved through mass production of standardized parts. A wide variety of permissible modifications are possible. For instance... five sizes of YR turbines cover the entire range of capacities up to 2000 hp, speeds from 800 to 7000 rpm and back pressures from 4 in. Hg to 250 psig. Standard designs of rotor, governor, bearings, bearing cases, steam chest, governor valves and governor linkage are used throughout. In the case of higher pressures and temperatures up to 850 psig and 900 F, materials for steam parts may be changed from cast iron to steel.

Here are a few of the design highlights that are included in Elliott turbines:

Air-wall labyrinth seals to protect bearings from contamination without rubbing contact.

Centerline support to provide constant alignment under any operating condition.

Stainless steel spray coating under packing glands to eliminate corrosion of the shaft.

Choice of many governors to meet specific control requirements.

Liner type bearings to eliminate the need for scraping and fitting.

Packing glands removable without raising turbine upper half casing to simplify inspection and maintenance operations.

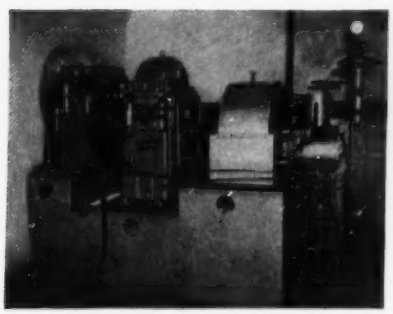
Stainless steel buckets and shroud to assure maximum life and continued high efficiency.

These and many other features are *standard* in Elliott turbines. They are the result of years of practical experience in the application of turbines to hundreds of different types of plant equipment and to many different types of operating and steam requirements.

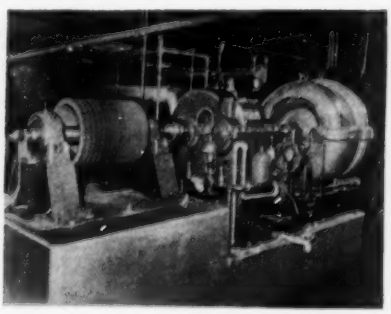
Full details on Elliott Mechanical Drive Turbines can be obtained from your local Elliott representative or by writing Elliott Company, Jeannette, Pa., for a descriptive bulletin.

ELLIOTT Company

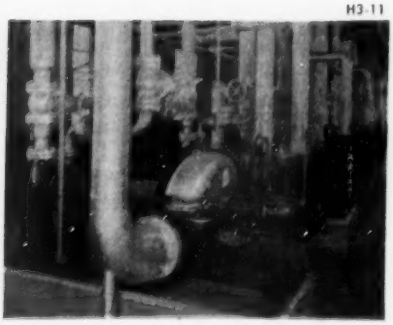
H3-11



This Elliott 202-hp turbine drives an induced-draft fan through a separate reduction gear, in a midwestern generating station.



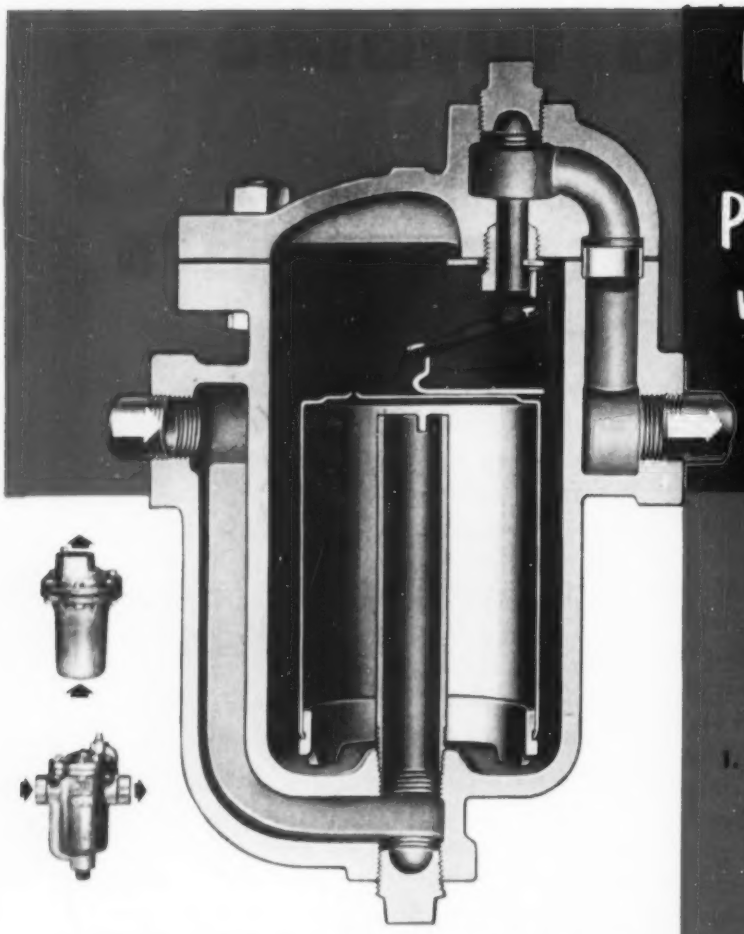
An Elliott 250-hp geared multi-stage turbine driving a paper machine. Governor gives close regulation over a wide speed range.



This line of oil pumps is driven by Elliott turbines. This is one of many refinery applications for Elliott turbines.

For more data circle 501 on Post Card

MORE TRAP CAPACITY PER DOLLAR with Armstrong two-phase leverage



Two-phase steam trap leverage is an original development by Armstrong and has been incorporated in Armstrong traps since the memory of most engineers runneth not to the contrary. It provides:

1. High initial leverage to open the valve against pressure.
2. Secondary lower leverage which permits the valve to travel well clear of the seat to minimize restriction to flow of condensate.

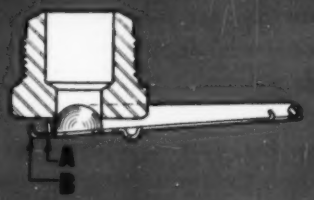
A single-phase lever can open just as large a valve *or* give just as great valve travel, *but not both*. Thus, Armstrong two-phase leverage gives very much greater capacity, depending on trap size than the earlier leverage system.

No steam trap gives greater actual hot condensate capacity, size for size, and dollar for dollar, than an Armstrong!

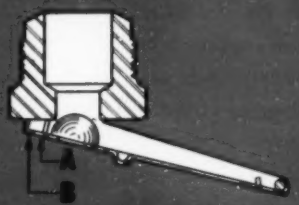
For complete data call your local Armstrong Representative or send for the 44-page Steam Trap Book.

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Michigan

HOW IT WORKS:



1. Valve in closed position.



2. As the bucket starts to sink, the lever fulcrums at "A", giving high leverage to open the valve against pressure. When valve is well open, the secondary fulcrum "B" touches the face of the valve seat.

3. Additional bucket travel results in fulcrum "B" becoming the pivot, permitting the valve to be opened wider so that restriction to flow of condensate is minimized.

ARMSTRONG STEAM TRAPS

For more data circle 502 on Post Card

ENGINEERS' PREVIEW

AN INTERESTING PROJECT has been carried on for a number of years by the National Bureau of Casualty Underwriters. This is the publication of a Synopsis of Boiler and Pressure Vessel Laws, Rules and Regulations by States, Provinces and Cities in the United States and Canada. This Synopsis attempts to indicate briefly and clearly the standards of construction and the relationship between the legally-constituted inspection authorities and the insurance companies and boiler manufacturers. A number of the states and one province in Canada do not have any state boiler laws up to the present time, but the Synopsis gives full details for those states that do have such laws, covering rules for construction and stamping, objects subject to rule for field inspection, inspections required, certificates, fees, and any other data that applies in that state.

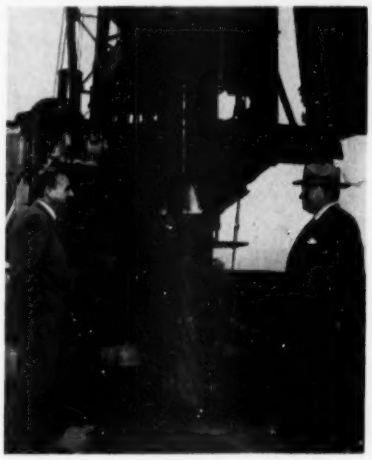
If you're interested, write the Engineers' Preview Editor, who will tell you how to get a copy of the Synopsis for which a small charge is made.

* * *

INTERNATIONAL NICKEL Company of Canada, Ltd., announced recently that in an historic mining development it was undertaking production of by-product iron ore from nickel ores in the Sudbury District of Ontario. This involves a trail-blazing new process that will supply iron ore higher in grade than any now produced in quantity in North America. Containing at least 65 per cent iron natural and less than 2 per cent silica, this ore will command a premium price for direct use in open hearth and electric furnace steel production. By comparison, ore from the famed Mesabi pits of Minnesota contains 51.5 per cent iron natural.

* * *

PILE DRIVING has started on Detroit Edison's River-Rouge power plant project, where the two largest steam generators in the world will be located. These will be two 260,000-kw units, the first of which is scheduled to go into operation early in 1956. The power house super structure will be of steel panel design. Two 400-ft stacks will rise from the ground level alongside the main structure. There will be dockage for lake coal carriers and storage facilities for over one million tons of coal. By the time the St. Clair plant is completed and both units of the Rouge plant are in operation, Detroit Edison's total generating capability will be more than 3 million kw.



When drilling starts on Detroit Edison's River-Rouge power plant project, Vice President George A. Porter, left, and President Walker L. Cisler stand by as giant auger is lowered into position. Note water jets at auger tip to wash debris to surface

* * *

RALPH E. FLANDERS, senior senator from Vermont, was named to receive the 1953 Howard Coonley Gold Medal, the nation's highest award in the field of standardization. It was presented at a meeting of the American Standards Association in New York in October. Senator Flanders is a past president of the ASME, a former vice president of the American Engineering Council, and until becoming senator in 1946, was president of the Jones and Lamson Machine Co.

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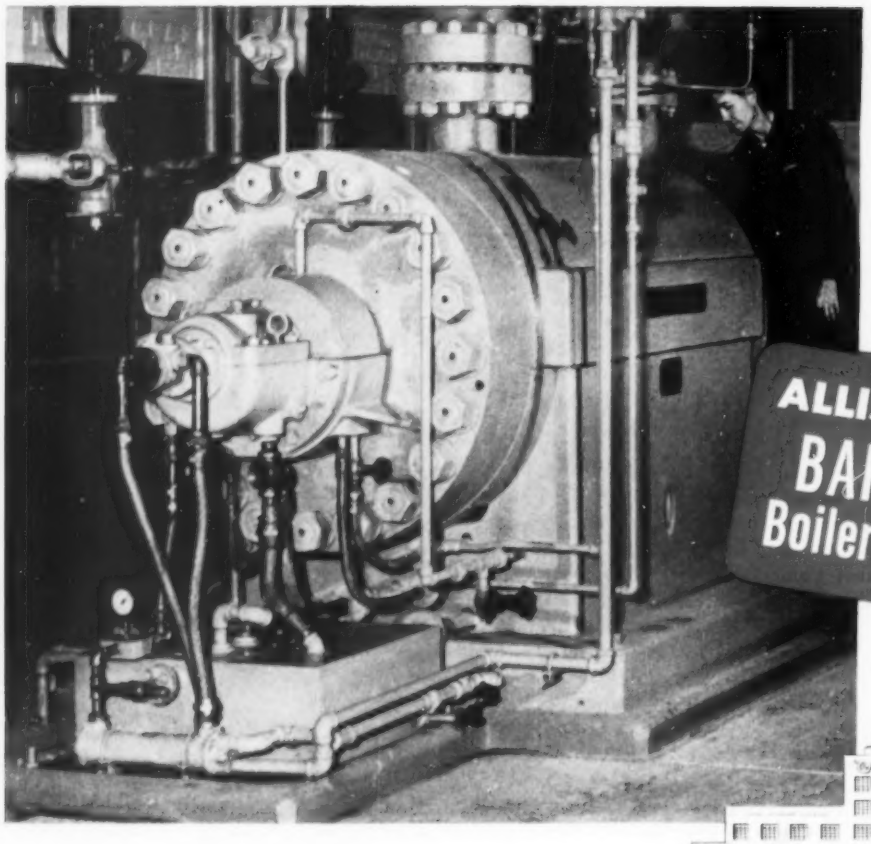
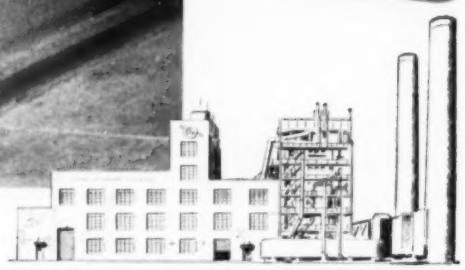


One of three barrel-type boiler feed pumps at the Lake Catherine station of Arkansas Power and Light Company. Rated at 525,000 lb/hr, 1800 psig discharge, 3575 rpm, water temperature 350 F. Station engineered by Ebasco Services, Inc.

ALLIS-CHALMERS
BARREL-TYPE
Boiler Feed Pumps



Chosen by Arkansas Power and Light because performance is service proved

Low maintenance, high efficiency

Low maintenance, high efficiency performance records in power plants in all parts of the country . . . that's what led Arkansas Power and Light Company to choose Allis-Chalmers barrel-type boiler feed pumps for their newest outdoor-type station.

Proved design features

Back of that performance record stand many proved design features. For instance, first stage has twin, single-suction impellers to give low NPSH requirement for highest efficiency under fluctuating loads. Impellers mounted back-to-back balance axial forces without balancing drum. Expansion joint and shaft seals are brought to outside of pump where they may be inspected often and worked on easily, if required.

Complete unit from one source

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 08B7899.

A-4286

ALLIS-CHALMERS

For more data circle 503 on Post Card

Inspecting full-scale wooden model of a portion of first large liquid-cooled generator are (left to right) Glenn B. Warren, G-E vice-president, Charles E. Kilbourne, G-E electrical engineer, Turbine Division, and H. Dana Taylor, manager generator engineering, G-E Large Steam Turbine-Generator Department

FIRST large, liquid-cooled generator in the history of the electrical industry will be the new 208,000-kw unit to be built by General Electric for the Eastlake power plant of the Cleveland Electric Illuminating Company. Manufacture of this unit will start early in 1954. Liquid cooling of the type used will make possible a significant increase, it is claimed, in capability of generators without increasing physical dimensions. Only the stator of the generator will be liquid-cooled by the method shown in the photograph.

* * *

ROCKLAND Light and Power Co., Nyack, N. Y., is supplying electric service to provide corrosion protection to about 150 merchant ships of the National Defense Reserve Fleet anchored in the Hudson River off Jones Point, N. Y.

Part of an emergency standby fleet, the vessels are continuously inspected and preserved above the water line by specialized working crews of the Maritime Administration. This agency has also been delegated the responsibility of underwater protection against corrosion through cathodic application of 24-v direct current to the ships' bottoms.

Small graphite electrodes have been laid on the river bottom beneath each ship and are connected electrically to rectifiers set up on the decks of selected vessels; a-c power to operate the rectifiers must be brought via submarine cable from the shore.

* * *

A. C. MONTEITH, vice president in charge of engineering, Westinghouse Electric Corp., was nominated as 1954–55 president of the American Institute of Electrical Engineers during the Society's Winter General Meeting in New York.

* * *

ALLOCATION of fissionable material as fuel for a nuclear reactor to be built by Pennsylvania State University has been approved by the U. S. Atomic Energy Commission. This will be a low-power "swimming pool" type of reactor to be operated for nuclear research and for training of students. It is the second privately-owned reactor for which the AEC has authorized the use of nuclear fuel. The first, built by the Consolidated University of North Carolina, began operation last September 5.

Cost of construction and operation of the reactor will be borne by the University. It will operate at a power level of 100 kw. It will be cooled and moderated with ordinary water and will use enriched uranium fuel. The fuel elements will be suspended in a pool of water deep enough to serve as a shield against the radiation. A similar swimming pool facility, the Bulk Shielding Test Reactor, has been in operation at Oak Ridge National Laboratory since 1952.

* * *

NEWLY-PERFECTED "robot" chemist may be opening the door to automatic processing in the gas, petroleum, pharmaceutical and chemical industries, says Ernest E. Johnson, general manager of the G-E General Engineering laboratory. Called the ion resonance mass spectrometer, the instrument makes possible continuous control of the mixture in a stream of multi-component gases or light liquids. It is termed an automatic chemical analyzer that writes the "signature" of the product being produced. Is it possible that some day we will see it in a boiler plant, analyzing the boiler flue gas and adjusting the fuel and air supplies to produce most efficient combustion?

* * *

VAPOR HEATING CORP. and its subsidiary, Roth Manufacturing Co., has moved its factory from 4501 W. 16th St., Chicago, to a new plant at 6420 W. Howard St., Chicago 31, Ill.

* * *

LIGHT'S Diamond Jubilee will reach its climax with a two-hour television show over three networks on or about October 21, 1954. This television show will follow the Jubilee's objectives of presenting the contributions of electrical progress to the development of this country and will emphasize the progress expected in the future through electricity.

* * *

WHEN DAWN breaks over a large city and the demand for electric power begins to rise, TPF will assist in determining moment by moment which of many generators in various generating stations should produce and transmit the increased power at the least possible cost. What is TPF? It is a new type of computer reported to the AIEE annual meeting by representatives of AG&E and G-E, which cooperated in developing it. Its full name is Transmission Penalty Factor Computer.

It is claimed to be the first device

of its kind designed to introduce transmission line losses as a factor in scheduling generation to meet changing demands in a large power system. It will be used in conjunction with an existing device that determines maximum economy from the point of view of fuel costs.

LETTERS TO THE EDITORS

The Conditions Are Directly Opposite

THE ARTICLE "How to Reduce Line Voltage Dips When Starting A-C Motors," by Edward H. Stivender on page 53 of the November 1953 issue, was very interesting due to its method of utilizing the synchronous motor.

At the present time we do not have any problem of power factor penalties or voltage dips from the starting of induction motors. However, I should like to be prepared for the future as hospital load increases.

Mr. Stivender recommends the use of an overexcited synchronous motor to raise voltage during the starting period. Does the action of the overexcited synchronous motor also function to correct power factor in the same manner as the stationary condensers frequently installed along secondary distribution lines?

Some years ago I operated a plant on a transmission system where the load at some hours of the day had such a strongly leading power-factor that it was necessary to operate both units in the station at no load and a very minimum of excitation on each unit. The condition originated immediately after a change of line voltage from 11 KV to 33 KV, and continued until inductive reactors were installed to absorb leading power factor.

It would appear that the condition treated by Mr. Stivender and the conditions in paragraph 4 are directly opposite. May I have a line or two to explain this matter.

Poplar Bluff, Mo. A. W. GRATKE

E. H. Stivender's Reply to Gratke

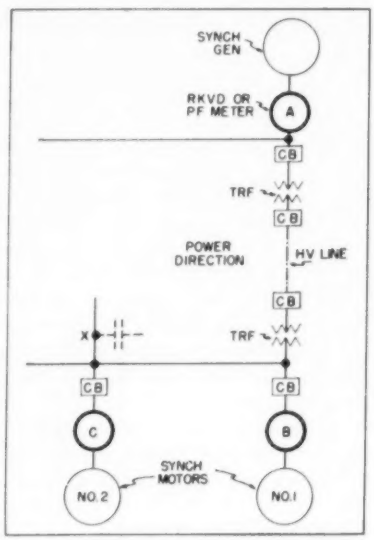
FIRST, to give specific answers to your two questions: an overexcited synchronous motor does function to correct power factor in the same manner as the stationary condensers frequently installed along secondary distribution lines, and the condition treated in my article and the condition described in paragraph 4 of your letter are directly opposite. In order to explain these answers, here are a few remarks on the subject which I hope will prove helpful to you.

In all these problems of voltage regulation and power factor control, the fundamental fact must not be overlooked that in any system, currents out of phase with the applied voltage, introduce line losses just the same as in-phase currents, and in many cases they bring about serious voltage regulation problems requiring additional equipment for their correction. Sometimes the transmission problems become so great as to discourage the use of long lines, and there are many cases where local isolated plants find it cheaper to generate their own power using diesels, rather than buy power, even when it can be obtained very cheaply.

If there is appreciable capacitance, induction motors should be selected in order to use the leading kva available and also to reduce the problems it presents. Should synchronous motors be used in these areas which have leading kva problems, their field excitations must be greatly reduced to absorb this kva. The fields of the motors can then become weak enough to reduce the output torque and hence the mechanical power output obtainable. As far as excitation is concerned, synchronous motors are exactly the same as synchronous generators; i.e. reducing or increasing the field strength of a synchronous motor affects the external circuit the same way as when these changes are made in the field of a synchronous generator. The excitation can come from the external circuit, in terms of wattless a-c, or from a d-c source applied to the field windings, or both. At all times the field of the motor has to be strong enough to enable the induced emf to balance the applied voltage. If we supply too much d-c, i.e. too much magnetization, then demagnetizing current has to be drawn from the line to neutralize this effect, and this demagnetizing current is leading current, so the motor acts like a condenser and draws leading current from the line. If, on the other hand, we underexcite the motor with insufficient d-c, then it automatically draws magnetizing or lagging current from the line to make up its excitation to the value it needs.

In the condition described in para. 4 of your letter, the leading line kva was so great that it was necessary to reduce the excitation to prevent a large voltage rise. If this reduction had been accomplished by reducing the d-c excitation, the reduction would have been so large that there would have been very little excitation available for torque. For this reason reactors were installed to neutralize the leading kva and thus leave the generator winding available for power current, with the reactors neutralizing the wattless current. Reactors neutralize excess leading current in the same way that condensers neutralize lagging current. Overexcited synchronous motors act as condensers, just as underexcited synchronous motors act as reactors.

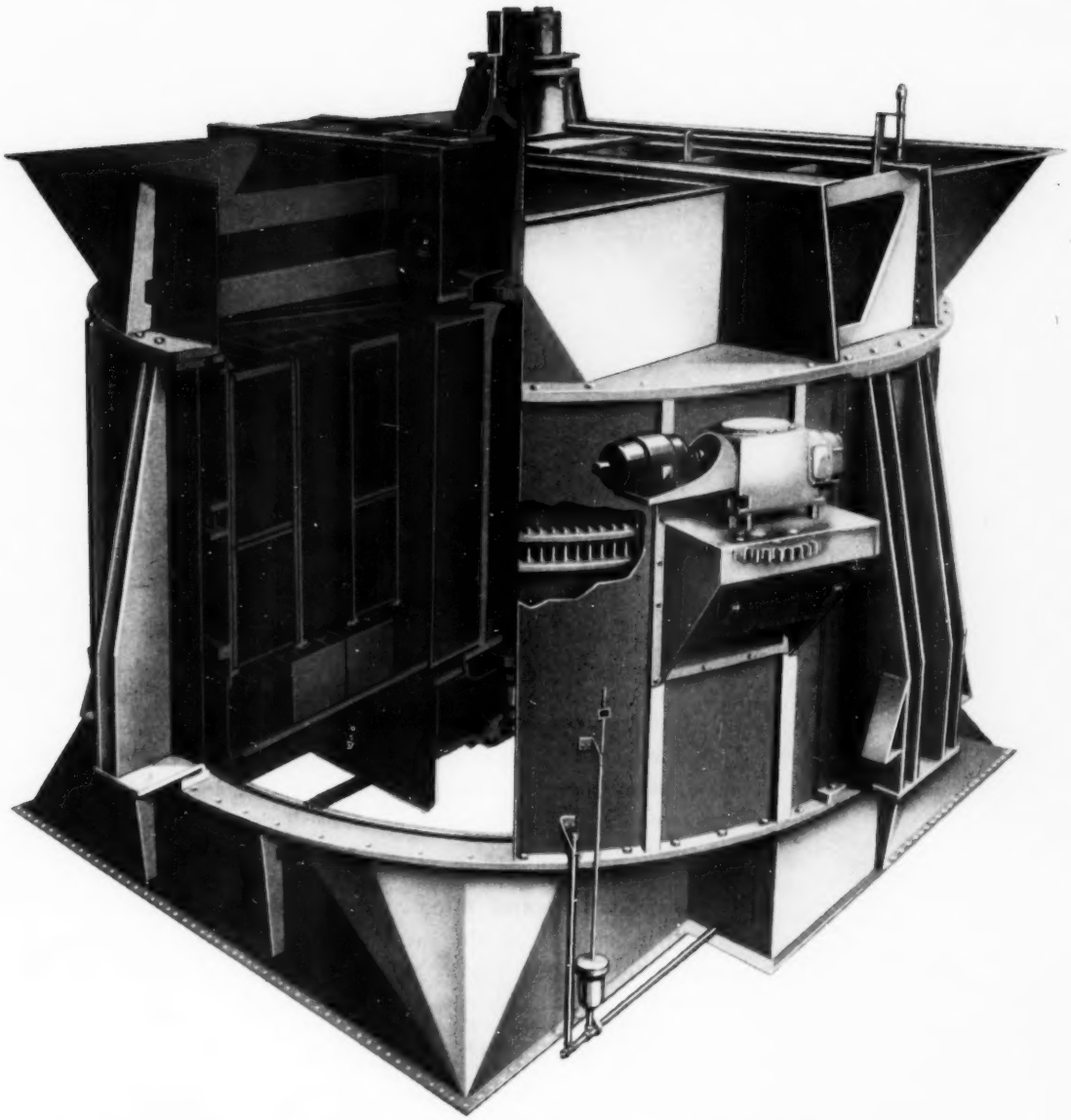
The accompanying diagram will help to explain these effects. Suppose the generator and No. 1 motor are running, and No. 2 motor is started up. This means that a large inductive reactive kva demand is temporarily thrown on the system. Meter A will read lag, Meter B will read lead and meter C will read lag. If neither motor is running and No. 1 is started, meter A will read lag and meter B will read lag. If all machines were running and a high capacitance load were thrown on at point X (this would correspond to connecting in a bank of capacitors or a line of high leading current demand), meter A would read lead and meters B and C would read lag.



Circuit used in Mr. Stivender's letter explaining how synchronous motors affect power factor

All the above lead and lag conditions are the result of each machine inherently tending to supply reactive kva in a direction and of a magnitude to sustain the set voltage at its terminals. The above is to caution one that the meter connections must be taken into account if more confusion is to be avoided in a study of these power factor conditions.

Fort Thomas, Ky. E. H. STIVENDER



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Improved Gaskets and Mica—"Frelon" gaskets are coated with a special compound to prevent sticking at disassembly—wire inserts for the higher pressures give "Frelon" gaskets greater strength—thicker mica for the higher pressure gages.

"Floating Assembly" Covers—improved capscrews have wider shoulders at face of body—improved spring cones reduce spring cone stresses.

Better Valves—YARWAY Welbond gage valves have integral stellite seats and stainless steel stems—Welbond water column shut-off valves have lock-open device.

YARWAY Gages are the "gages to see" on all new boiler units or replacements in high-pressure installations.

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114 Mermaid Avenue, Philadelphia 18, Pa.
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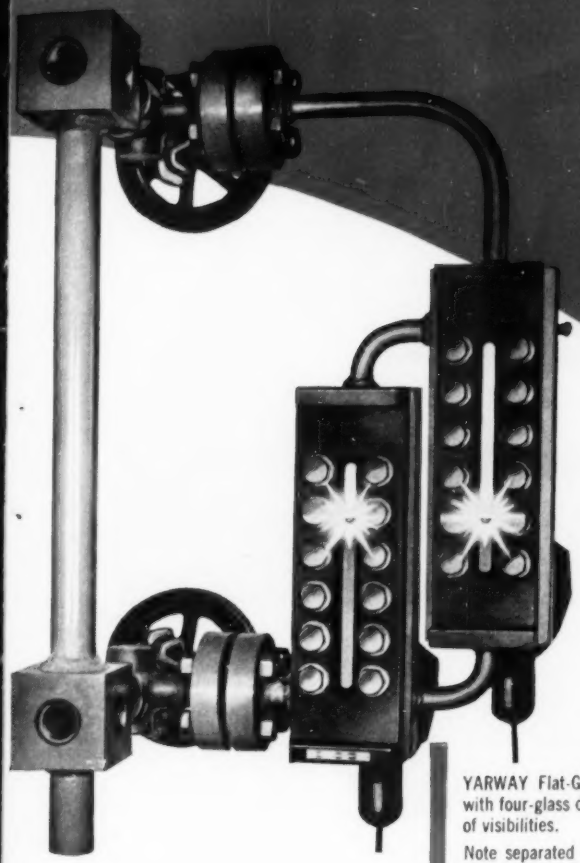
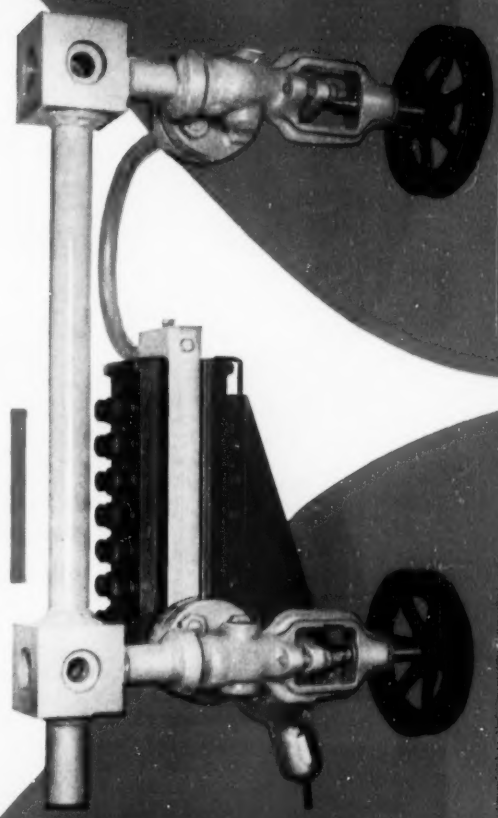


YARWAY Flat-Glass Water Gage Assembly with four-glass double insert for long ranges of visibilities.

Note separated design, interconnecting expansion loops, flanged connections (1½" tie-bar-type circulating water column) and Type "M" Illuminators that make meniscus at water level "shine like a star".



YARWAY Single Insert type gage for medium range of visibilities. Note expansion loop and flanged connections. YARWAY Welbond Gage Valves assure highest dependability in high-pressure service.

Close-up of YARWAY Type "M" Illuminators on above 4-glass insert assembly. The blue-white illumination is visible for distances up to 125 ft. and is especially effective in penetrating deposits on gage glasses, dust particles in the air and extraneous light.

YARWAY

water columns and gages

NOW

. . . the most compact, *complete* burner in the industry for *fully automatic operation!*

the PEABODY PK-54

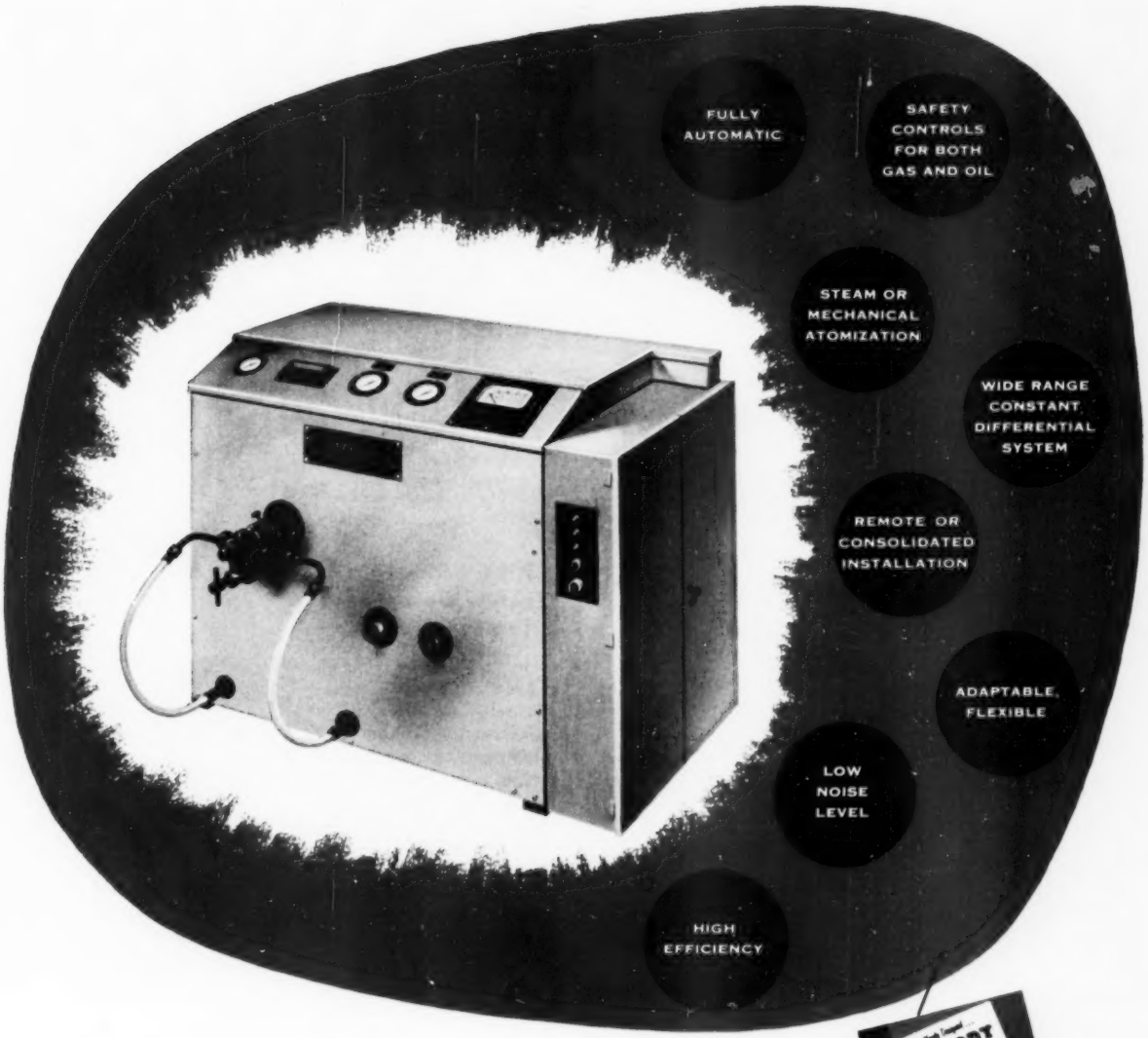
Designed and built to fire steam generating units with gas or oil, singly or in combination, to 42,000 lbs. steam per hour . . .

The result of years of research engineering and combustion experience, the modern Peabody PK-54 Burner is the most compact, complete and flexible burner for automatic operation in the industry. Extremely adaptable, the PK-54 is furnished with a factory-packaged control cabinet which can be mounted as an integral part of the unit or remotely located, depending upon job requirements. A fuel oil pump and heater set can also be included if desired. This modern burner features a new and proven air handling arrangement that assures operation with minimum excess air and maximum efficiency over an extended operating range. Wide range steam or mechanical atomizing, utilizing Peabody's constant differential principle of operation is used for oil firing. Continuous combustion and safety controls, for both gas and oil, are only a few of the many unique features built into this, the newest of a long line of burners known for efficiency for more than a quarter of a century.

Nameplate of Efficiency

PEABODY ENGINEERING CORPORATION

580 FIFTH AVENUE, NEW YORK 36, N. Y.



The Peabody PK-54 operates throughout an extended burner range and recycles without operator assistance in case of an operational shut-down. Each unit includes burner and blower, as well as an entire system of combustion, safety, and sequential controls—all of which are integrated by a modern design that's been tested and proved to be safe, outstandingly efficient and extremely adaptable.

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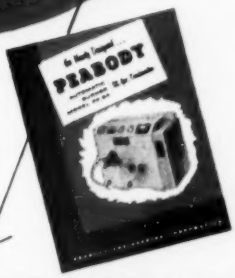


PEABODY

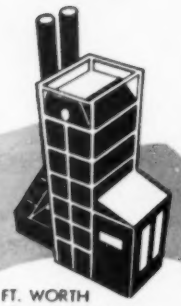
ENGINEERING CORPORATION

Gentlemen:
Please send me Bulletin 430 giving details and specifications on the Peabody PK-54 Burner.

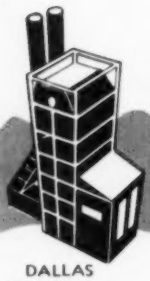
Name _____ *Title* _____
Firm _____
Address _____
City _____ *Zone* _____ *State* _____

For more data circle 506 on Post Card

MORE POWER

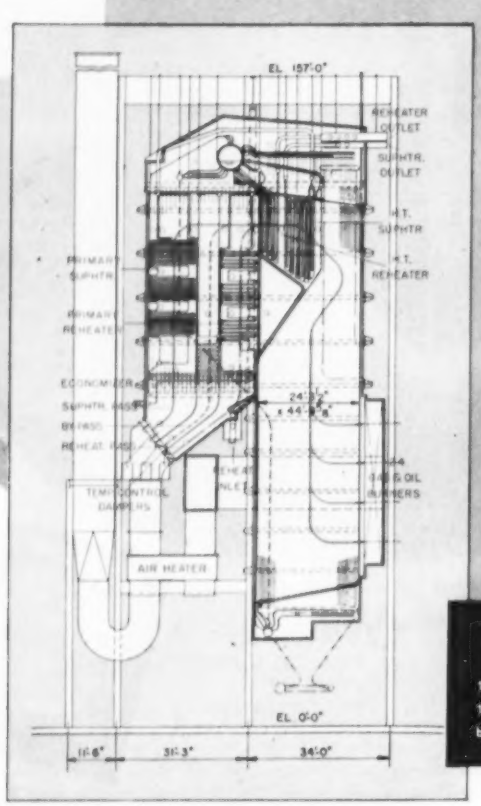


FT. WORTH
Texas Electric Service Company



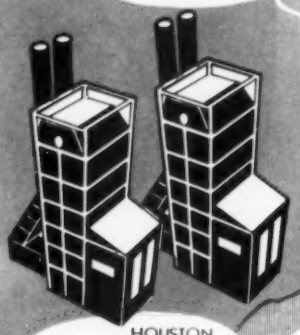
DALLAS
Dallas Power & Light Co.

LAKE CHEROKEE
Southwestern Gas & Electric Co.



RILEY Reheat Units Feature Damper Steam Temperature Control

In these Riley Reheat designs both steam and reheat temperatures are maintained constant by damper control. Dampers located below the economizer automatically proportion gases over primary reheater and superheater surfaces. At high loads, part of flue gas passes through open lane between superheater and reheater surfaces.



HOUSTON
Houston Lighting & Power Co.

TEXAS ELECTRIC SERVICE COMPANY — FT. WORTH

1,250,000 lbs./hr. capacity — 2125 psig 1005°F Superheat — 1005°F Reheat. Fired by Gas & Oil — Ebasco Services, Engineers

TRADE MARK REGISTERED

RILEY
STOKER CORPORATION

WORCESTER, MASS.

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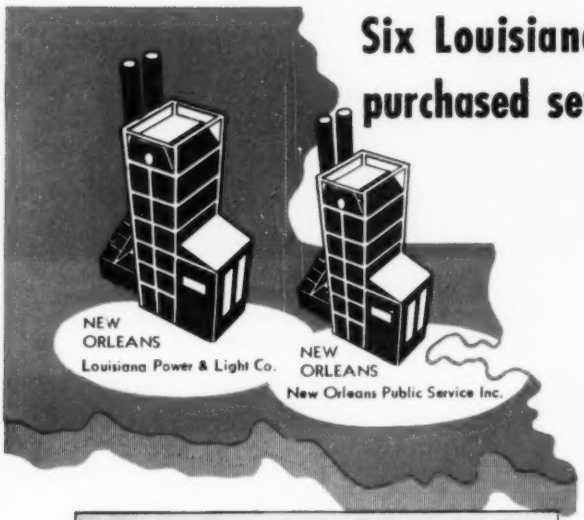
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS
WATER-COOLED FURNACES • STEEL CLAD INSULATED SETTINGS • AIR HEATERS

TO THE SOUTH!

Recent Public Utility Orders Predominantly Riley . . . .



Six Louisiana and Texas Public Utilities recently purchased seven steam generating units from Riley

Louisiana Power & Light Company
1,000,000 lbs./hr. Reheat Unit—Ebasco Services, Engineers

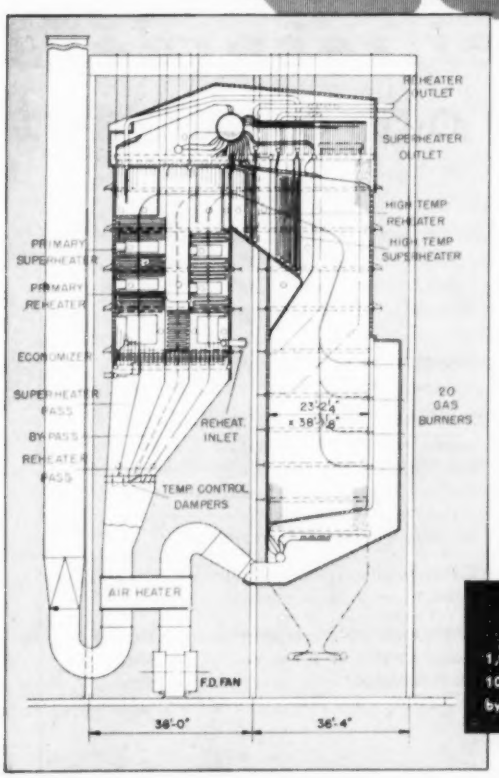
Texas Electric Service Company
1,250,000 lbs./hr. Reheat Unit—Ebasco Services, Engineers

Houston Lighting and Power Company
2—1,250,000 lbs./hr. Reheat Units—Ebasco Services, Engineers

Dallas Power and Light Company
1,050,000 lbs./hr. Unit—Ebasco Services, Engineers

New Orleans Public Service, Inc.
975,000 lbs./hr. Unit

Southwestern Gas & Electric Company
650,000 lbs./hr. Unit—Sargent & Lundy, Engineers



LOUISIANA POWER & LIGHT COMPANY — NEW ORLEANS
1,000,000 lbs./hr. capacity — 1725 psig — 1005°F Superheat—1005°F Reheat. Fired by Gas & Oil—Ebasco Services, Engineers

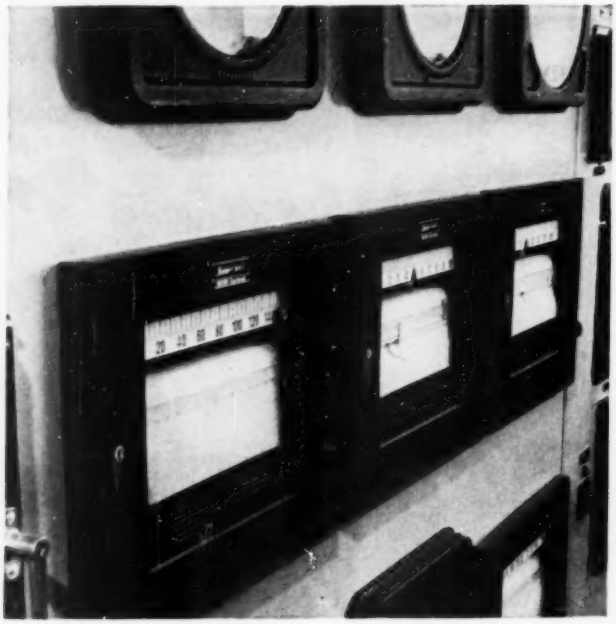
In 1953 an impressive array of Texas and Louisiana public utilities have teamed up with Riley. Houston Lighting and Power Company, long a satisfied Riley customer, recently ordered two Riley 1,250,000 lbs./hr. Riley reheat units, giving them eleven Riley units with a capacity of 6,890,000 lbs./hr. Texas Electric Service Co. has one Riley reheat unit on order. In addition, Dallas Power & Light Company will install a 1,050,000 lbs./hr. Riley steam generating unit, and only recently New Orleans Public Service, Inc. has ordered a 975,000 lbs./hr. Riley unit, its second Riley boiler.

In 1952, both Southwestern Gas & Electric Company and Louisiana Power & Light Company placed their first orders with Riley. Louisiana Power and Light Company's 1,000,000 lbs./hr. unit will be the World's first reheat unit fired by natural gas.

This sales record shows that when it comes to the largest steam generating units more and more public utilities are swinging to Riley. If you, too, are considering steam generating additions to your power facilities it will pay to learn first what Riley can do for you.

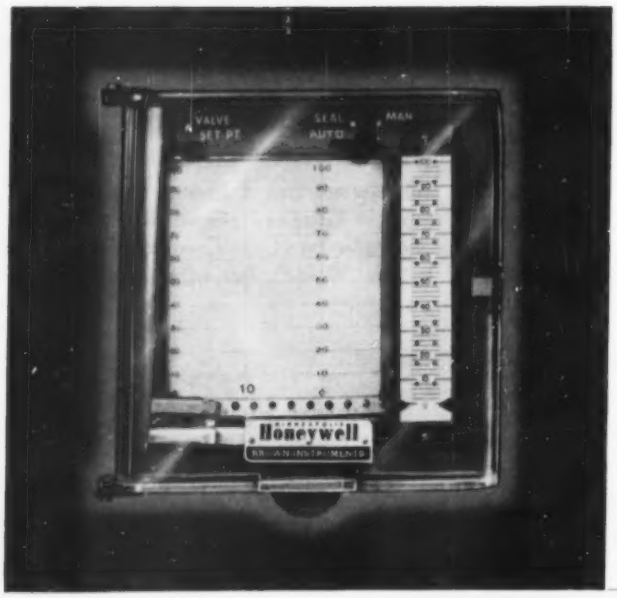
For more data circle 507 on Post Card

FUNCTIONAL DESIGN *is the keynote of the New Murray Gill Station designed by Ebasco for Kansas Gas & Electric Co. Above is an outdoor-mounted 47,000-kw generator unit.*



ON THE BACK OF THE CONTROL PANEL *are grouped full-size instruments such as these* ***ElectroniK*** *temperature recorders. But look on the operating side . . .*

Tel-O-Set recorders on compact



Every feature you need in a miniature recorder

Tel-O-Set recorders are applicable to measurements of temperature, pressure, flow and liquid level. They embody a simple, rugged pneumatic receiving system that is actuated by low-pressure air from the remote transmitter.

The recording chart moves horizontally. A full 8-hour record is quickly available.

The panel cutout required is only five inches square. In the mounted position, the instrument can be withdrawn from its case for easy inspection and adjustment.

For more data circle 508 on Post Card

...**THE FRONT OF THE PANEL,** *only eight feet in length per unit (two units shown), where operators can watch pertinent plant variables on miniature instruments mounted directly on a functional plant diagram.*

show critical trends graphic control panels

BOILER and turbine control panels, which used to stretch for dozens of feet along the sides of a central control room, are now being compressed into small, convenient size. The key to this new technique, pioneered by Ebasco in the power industry, is graphic instrumentation . . . which displays all vital operating variables on a plant diagram. Graphic panels bring complete plant operation into sharp focus . . . improve operator's efficiency . . . speed training of new men . . . and simplify start-up and emergency control.

For displaying the many variables which need more than instantaneous indication, *Tel-O-Set* miniature recorders are ideal on graphic panels. They take no more panel space than many dial indicators. And they provide a record which reveals trends, so that operators can know which way related variables are moving, and how fast.

When you're planning graphic instrumentation, plan to utilize *Tel-O-Set* recorders for these essential "trend indicators." Your nearby Honeywell sales engineer will be glad to discuss how they can be applied to your own control panels. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* Wayne and Windrim Aves., Philadelphia 44, Pa.

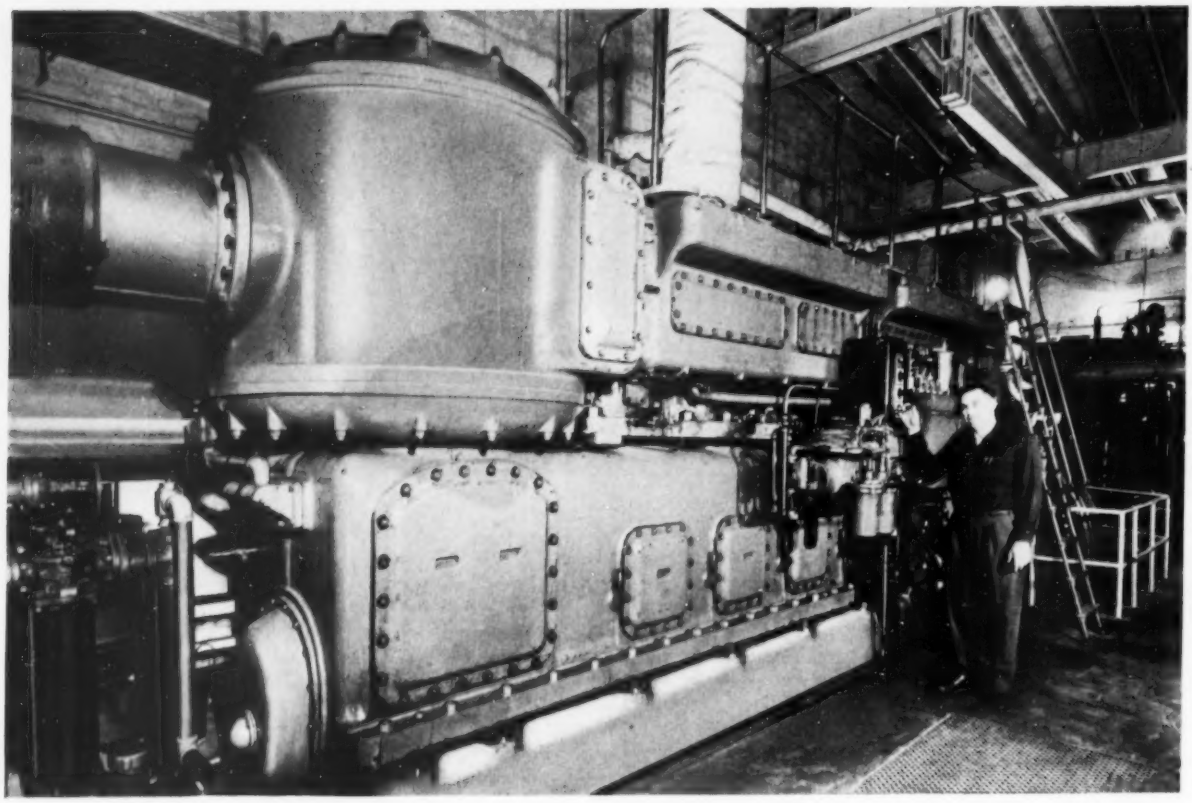
● **REFERENCE DATA:** Write for new Bulletin No. 9050, "Instrumentation for Steam Generation."

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

"Our tests show Gascon® Oils best!"



. . . says A.E. Harms, CHIEF ENGINEER

YUKON MILL AND GRAIN COMPANY, YUKON, OKLAHOMA

It's *doubly* important that the Yukon Mill and Grain Company's 5 diesels operate with as little trouble as possible. For this plant not only supplies power for the mill, but also for the City of Yukon.

Chief Engineer Harms writes, "When we changed to Sinclair GASCON Oil D-HD, the results were extremely satisfying – wear has been greatly reduced, varnish is gone from pistons and cylinders and stuck rings are a thing of the past. As you might expect, we now use Sinclair exclusively."

You too, can rely on Sinclair's full line of top quality diesel lubricants. Phone your local Sinclair representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save wear and replacements

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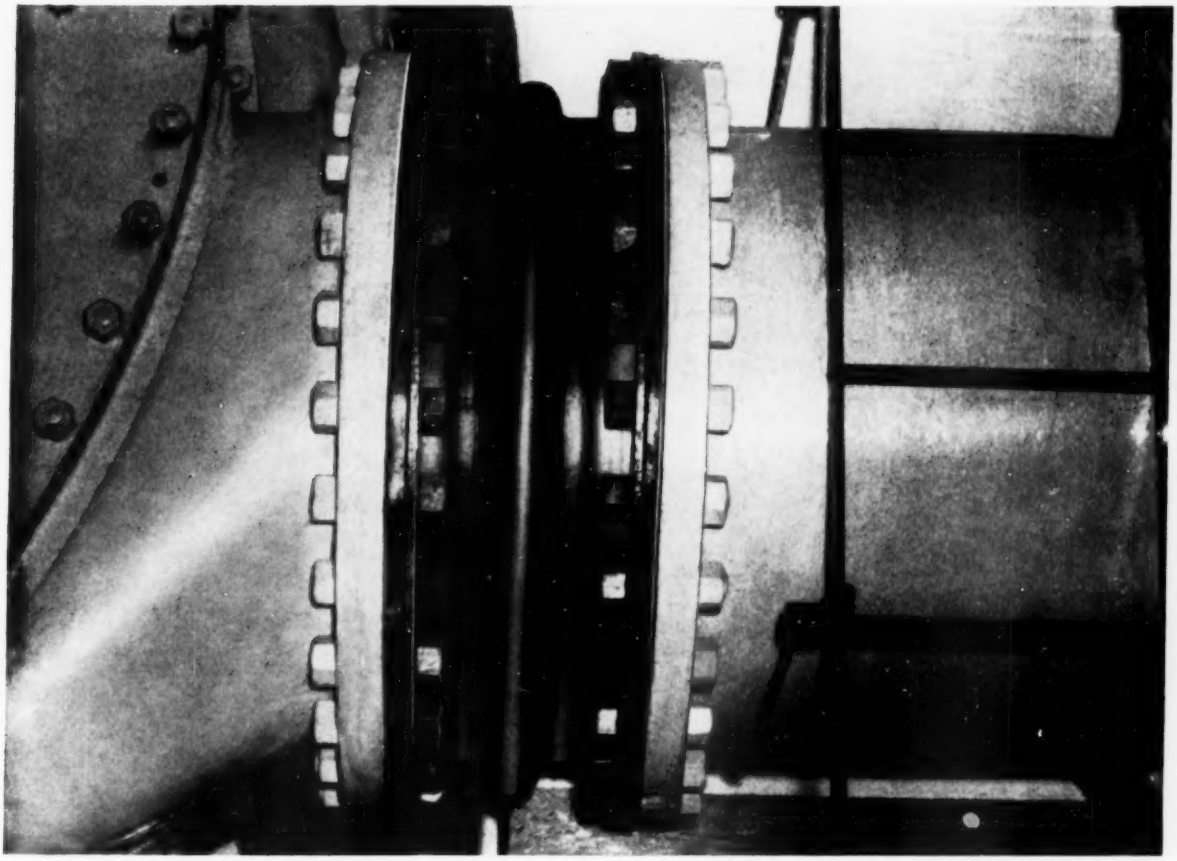
28 years old... but there's a lot of life in the old joint!



Back in 1926, this 30" x 12" U. S. Expansion Joint was installed in a Louisiana power plant. This rubber joint is still in fine working condition. Age has not impaired its efficiency. Three other U. S. Joints in this plant are the same age, are still performing well... and one of them has been used continuously in the valve end inlet header water circulation line in a *very moist location.* Our service engineers report it has many more years of fine service still ahead!

In United States Rubber Company's Expansion Joint Line are standard types to meet the majority of general industrial requirements on pressure or vacuum lines–insulating against vibration, compensating for expansion or contraction. Joints can also be designed and built to meet your own specifications. You can always rely on U. S. Expansion Joints to lengthen the life of equipment, save many times their original cost.

Get in touch with any of United States Rubber Company's 25 strategically located District Sales Offices, each staffed with engineers to serve you, or write to address below.

U.S.RUBBER
SERVING THROUGH SCIENCE

"U.S." Research perfects it
"U.S." Production builds it
U.S. Industry depends on it

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

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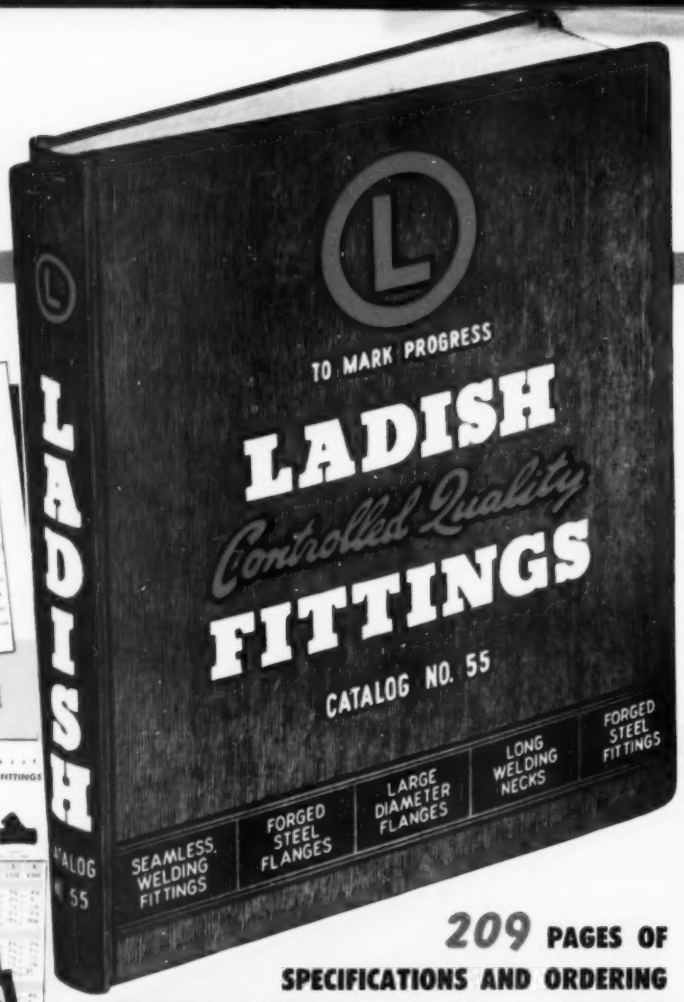
FITTINGS CATALOG NOW



209 PAGES OF SPECIFICATIONS AND ORDERING INFORMATION ON *Controlled Quality* FITTINGS

Here are detailed dimensions, weights and specifications to assist in selecting proper fittings for any application. Featured are a number of Ladish developments which improve piping efficiency. Major product listings by sections include:

68 PAGES BUTT WELDING FITTINGS
Available in Standard through Double Extra Strong weights . . . in sizes ½ through 42 inches.

56 PAGES FORGED STEEL A.S.A. FLANGES
Available in 150 through 2500-pound pressure ratings . . . in sizes ½ through 24 inches.

20 PAGES LARGE O.D. AND T.E.M.A. FLANGES
Available in a complete range of types and pressure ratings . . . in sizes up to 160 inches in diameter.

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Available in 150 through 2500-pound pressure ratings . . . in sizes from 1 through 24 inches.

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Available in diameters up to 240 inches in a wide variety of forged contours . . . in weights up to 40,000 pounds.

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Screwed and Socket-Welding types in 2000 through 6000-pound pressures, sizes ⅛ through 4 inches.

12 PAGES STAINLESS AND ALLOY FITTINGS
Featuring data on properties of materials and a comprehensive table of piping specifications.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

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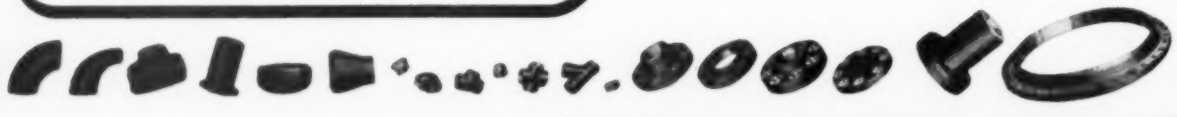

New LADISH *Catalog*

Provides detailed specifications on complete fittings line plus useful technical data to help solve piping problems

New from cover to cover and thoroughly up to date in latest provisions of codes and standards—this catalog presents a line broad and completely integrated in types, sizes, ratings and materials.

Easy to use . . . for it is fully tabbed with each section having its own pictorial index and table of contents. Durably bound, this book is a reference work on forged and seamless welding pipe fittings and flanges.

56 PAGES OF TECHNICAL DATA WITH LATEST CODE PROVISIONS SIMPLIFY DESIGN PROBLEMS

For busy engineers here are tabulations of pre-calculated values derived from frequently used design formulae which can be applied directly to the solution of piping problems with a minimum of computations. In addition to data on dimensional tolerances, friction loss and material specifications, this section contains valuable tables on:

ALLOWABLE STRESS AND P/S VALUES

Presented here in an easy to use form, these values help solve problems of wall thickness and working pressures in gas, power, district heating, refrigeration, oil transmission and refinery piping.

MAXIMUM WORKING PRESSURES

Tabulations for ½ through 30-inch pipe in a wide selection of wall thicknesses and materials for operating temperatures from 100° F. through 1500° F., in power, district heating, oil transmission, refinery and gas piping systems.

FLANGE PRESSURE-TEMPERATURE RATINGS

Tabulations feature new ratings for a wide range of materials for temperatures from 100° F. through 1500° F.

PROPERTIES OF PIPE

Dimensional characteristics of carbon, alloy and stainless steel pipe in commonly used nominal sizes and wall thicknesses to help solve problems of anchorage, heat loss and insulation.

FLOW THROUGH ORIFICES AND NOZZLES

Discharge through orifices, nozzles and short tubes are tabulated for a wide range of pressures up to 5000 P.S.I. and diameters from 1/64 through 1¼ inches.

LADISH CONTROLLED QUALITY
Pressure-Temperature Ratings for Ladish Forged Carbon and Alloy Steel Pipe Flanges
LADISH CONTROLLED QUALITY
Table of PROPERTIES of PIPE (Cont.)
LADISH CONTROLLED QUALITY
FLOW THROUGH ORIFICES, NOZZLES AND SHORT TUBES
LADISH CONTROLLED QUALITY
OR TRANSMISSION LINES OUTSIDE CITY OR VILLAGE LIMITS
OR PIPING SYSTEMS WITHIN REFINERY LIMITS
LADISH CONTROLLED QUALITY
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MAXIMUM ALLOWABLE WORKING PRESSURES

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LADISH CO.
Dept. POE, Cudahy, Wisconsin

Please send me, without cost or obligation, the new 304-page Ladish Fittings Catalog No. 55.

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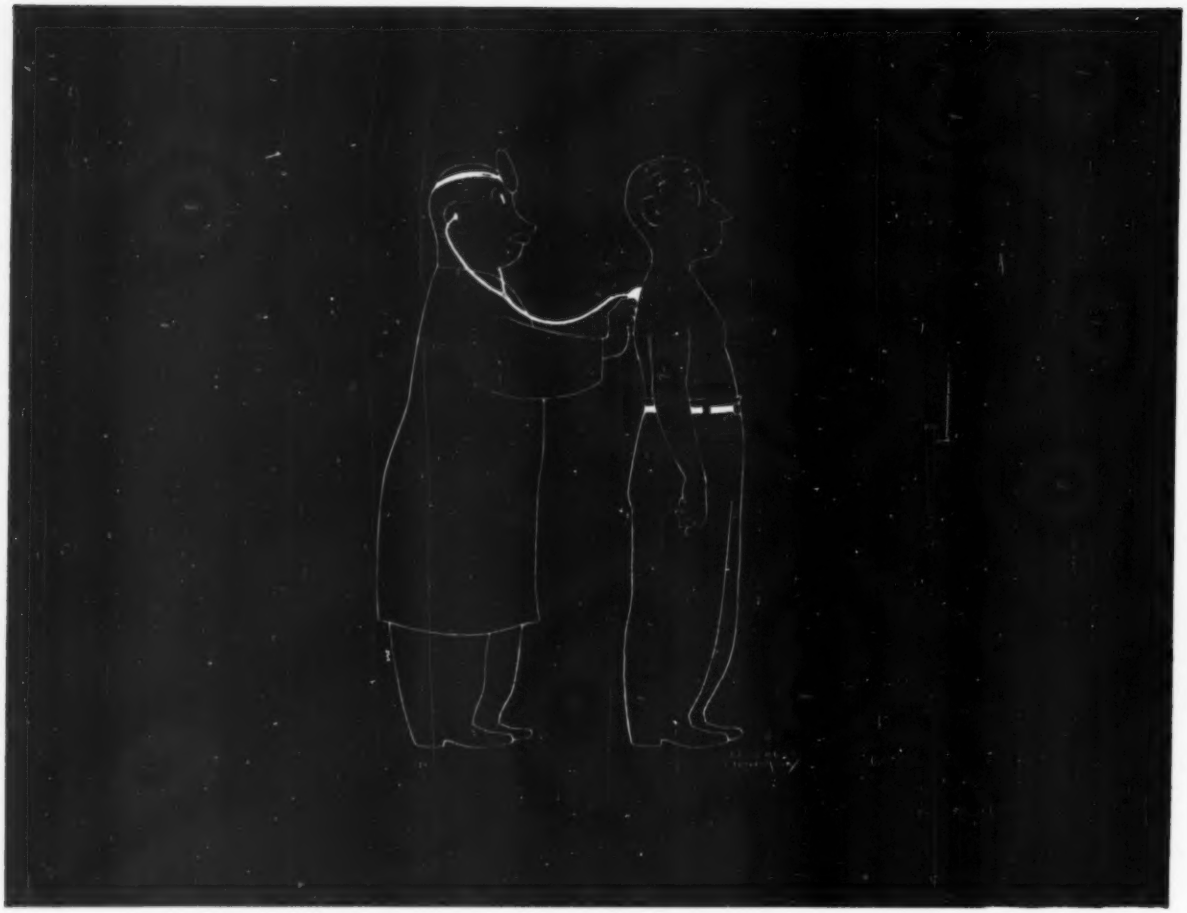

. . . before it TALKS

. . . is the way our doctors put it—"Our chances of curing cancer are so much better when we have an opportunity to detect it *before it talks.*"

That's why we keep urging you to make a habit of having periodic health check-ups, no matter how well you may *feel* . . . check-ups that *always* include a thorough examination of the skin, mouth, lungs and rectum and, if you are a woman, the breasts and generative tract. Very often doctors can detect cancer in these areas long before the patient has noticed any symptoms in himself.

The point to remember is that most cancers are curable if properly treated before they begin to spread, or "colonize" in other parts of the body. . . For other life-saving facts about cancer, phone the American Cancer Society office nearest you or write to "Cancer"—in care of your local Post Office.

American Cancer Society

here's how high temperature piping can flex its muscles

Each pipe hanger is scale tested to rigid tolerances by a skilled workman at the Navco plant. After final assembly and inspection, the hangers are carefully crated and readied for shipment.

NAVCO *Counterpoise* Pipe Hangers

Since high temperature piping has no respect for equipment connections, the entire piping system must flex its muscles to absorb the strain of expansion and contraction. This prevents serious stresses that could endanger the installation.

And how does high temperature piping flex its muscles? With Navco's precision engineered Counterpoise Pipe Hanger—the hanger with a load-supporting effort that is of constant value throughout the range of travel. This permits weightless movement of the entire piping system.

To learn how power plants, oil refineries and chemical plants can have piping systems that flex their muscles, write today for Navco's 12-page Counterpoise hanger bulletin #153.

NAVCO

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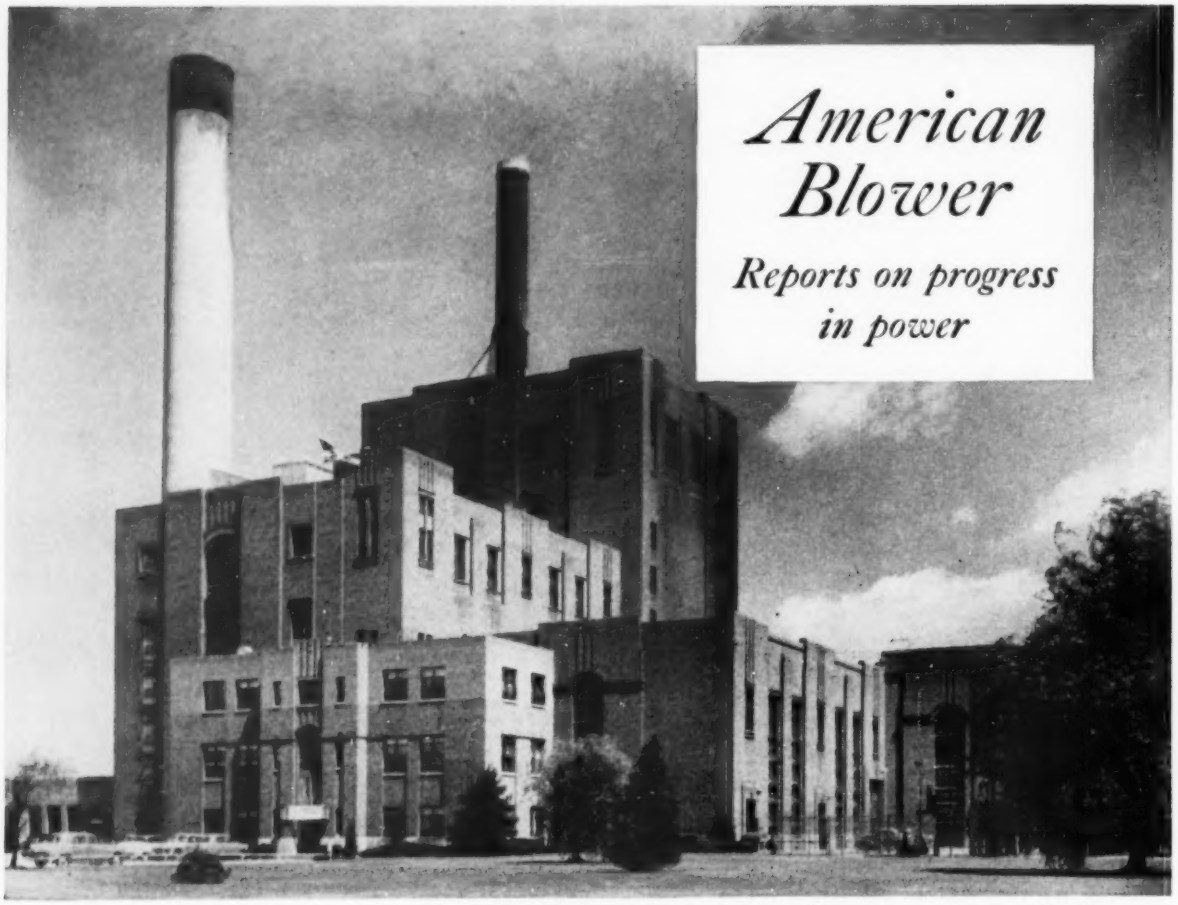
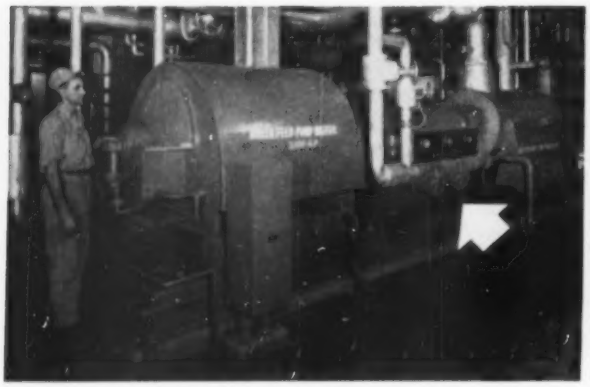
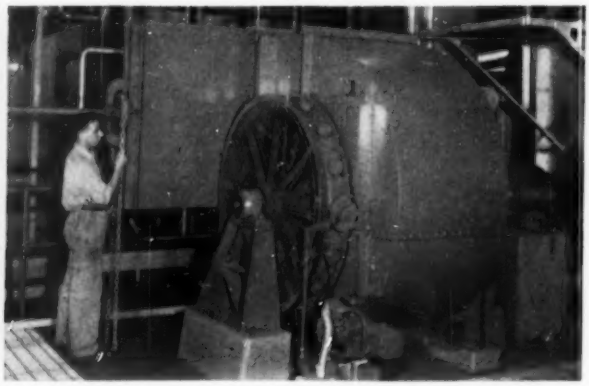


Pennsylvania Power's New Castle Power Plant serves the needs of a 1400 square mile area in western Pennsylvania.

Penn Power adds 85,000 kw. steam-electric

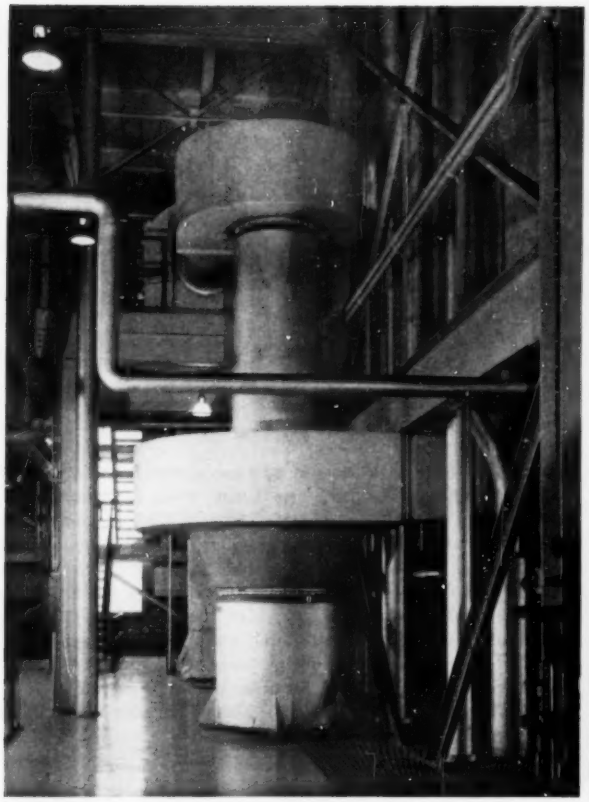


An American Blower Gyrol Fluid Drive (arrow) controls the Boiler Feed Pump at Pennsylvania Power's New Castle Plant.

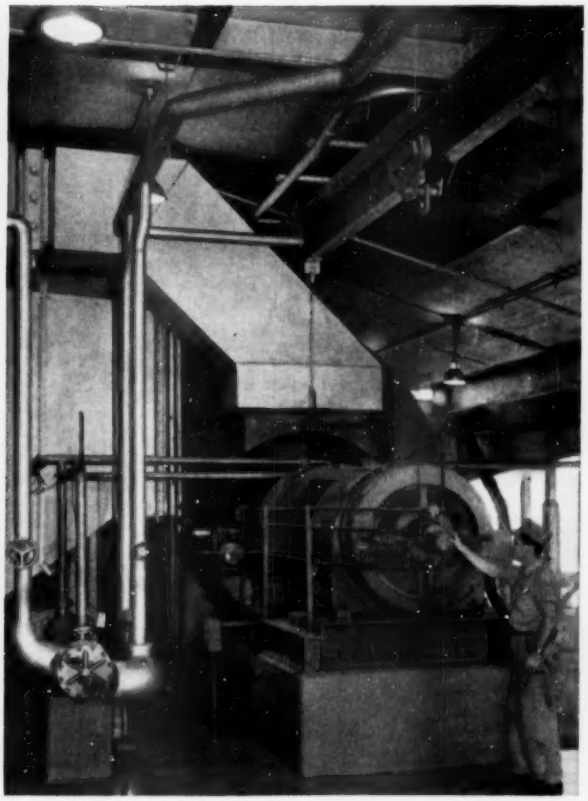


Shown above is an American Blower Tempering Air Fan for use with the new generating unit. It is a single width fan.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS

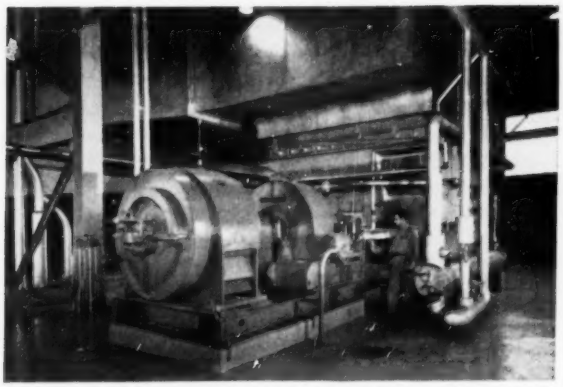


American Blower Fly Ash Precipitator and Secondary Dust Collectors are installed in the New Castle Plant's new generating unit. Primary collectors have capacities of 315,000 cfm at 275° F. and 2.2" SP wg, 210,000 cfm at 275° F. and 1.07" SP wg, and 105,000 cfm at 275° F. and 0.32" SP wg.



Shown is double width, double inlet American Blower Forced Draft Fan being driven through an American Blower Gyrol Fluid Drive. Its capacity is 230,000 cfm of 100° F. air at 12" wg static pressure. American Blower engineers will help you plan mechanical draft equipment for your exact needs.

generating unit



Sirocco Induced Draft Fan with Gyrol Fluid Drive, has capacity of 350,000 cfm of 275° F. gas at 15" wg static pressure.

Like other investor-owned electric utilities, Pennsylvania Power Company is constantly planning ahead to meet future electricity needs.

The latest expansion – an 85,000 kilowatt turbo-generator for the New Castle Power Plant – is the largest in the company's history. Not counting transmission facilities, the new addition represents an investment of $12,771,000.

American Blower products – Mechanical Draft Fans, Dust Collecting Equipment and Gyrol Fluid Drives – are used in the new Pennsylvania Power generating unit because of their proven dependability and long-term economy.

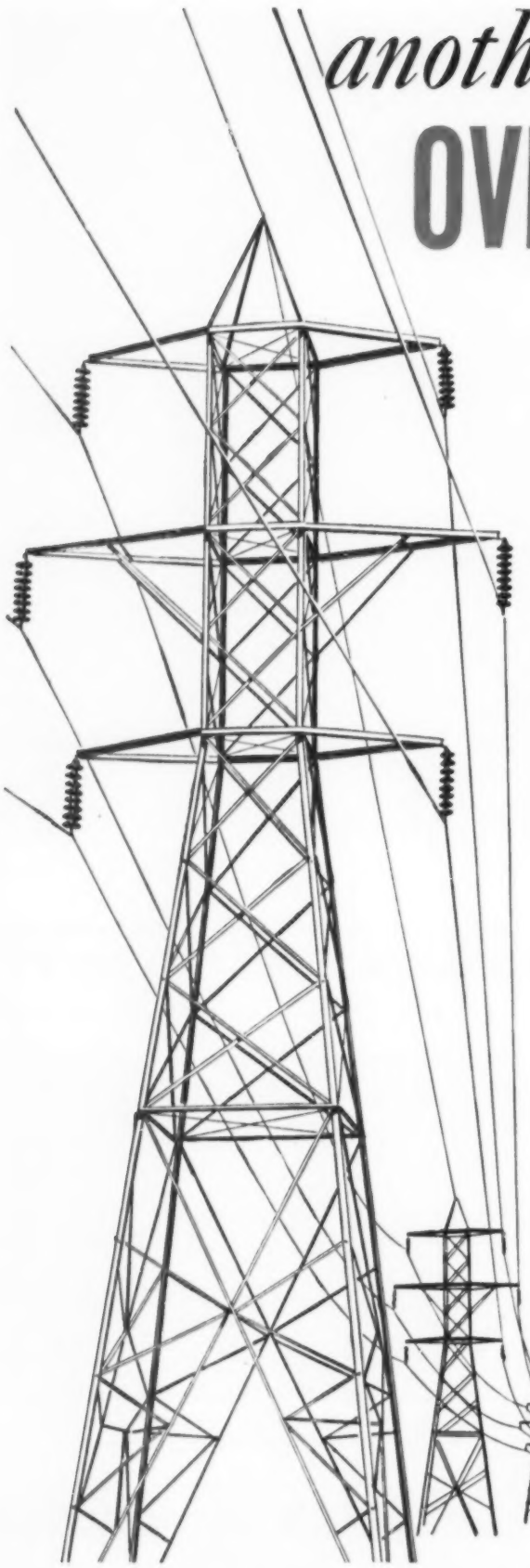
American Blower engineers will be pleased to co-operate in *your* expansion program. Consult the nearest American Blower Branch Office or write us direct.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, CANADA
Division of American Radiator & Standard Sanitary Corporation

KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

AMERICAN BLOWER

For more data circle 513 on Post Card



another great record

OVER 9,000,000 ON THE

Over nine million kilowatts of new thermal and hydro-generating capacity put on the line during 1953, again offers proof that America's power companies are fully aware of their tremendous responsibility for the growth and progress of this nation. The continuing program of expansion being carried out is a monument to the foresight of power executives and engineers. The astonishing strides they have made toward more efficient utilization of fuel, and the rapid implementation of new engineering developments for universal benefit, mean that electricity will continue to be America's Best Bargain. Their achievements represent many decades of prodigious, cooperative work; of sound preliminary planning and long range vision.

A considerable portion of this new capacity—well over 4,000,000 KW . . . is being generated by B&W Boilers of all types put in service during 1953. Represented are B&W Radiant, Stirling, Open Pass, and Integral-Furnace Units, embodying every major advance in the science of modern combustion and steam generation. Cyclone Furnaces, Pressure Firing, Reheat, Divided Furnace Construction, and Cyclone Steam Separators, all proved by years of intensive operating experience, are included in these units—singly or in combination, as indicated by individual circumstances and conditions—to effect the greatest possible generating economies:

- **Thirteen of these units are for design pressures over 2000 psi—all with Cyclone Steam Separators for natural circulation**
- **Four are Cyclone-Furnace-Fired**
- **Nineteen are for Pressurized-Furnace-Firing**
- **Eighteen—including the largest units of their kind—are equipped with reheaters**
- **Twenty have B&W's simple Divided Furnace construction for maximum savings in building volume**

The experience and advanced technology reflected in B&W's contribution to this huge volume of new capacity is a good indication of the confidence placed in B&W by electric utilities at home and abroad . . . confidence based on the sound platform of past experience. B&W's wealth of research and creative engineering talent, its broad and diversified facilities, are available to help you find the most efficient and economical solution of your steam power problems.

set by America's Utilities
KW OF NEW CAPACITY LINE IN 1953

ONE OR MORE B&W BOILERS WERE PLACED IN SERVICE FOR THE FOLLOWING UTILITIES IN 1953

Appalachian Elec. Power Co.
Braintree Electric Light Dept.
Central Louisiana Electric
City of Burbank, California
City Electric Light Company, Brisbane, Australia
City of Glendale, California
City Public Service Board, San Antonio, Texas
Commonwealth Edison Co.
Consolidated Gas Elec. Lt. & Pr. Co. of Baltimore
Consolidated Edison Co. of N. Y., Inc.
Consumers Power Co.
Dallas Power & Light Co.
Detroit Edison Co.
Duquesne Light Co.
Electricite de France
Florida Power Corp.
Gulf Power Co.
Houston Lighting & Power Co.
Indianapolis Power & Light Co.
Iowa Public Service Co.
Iowa-Southern Utilities Co.
Isefjord Power Co.
Jersey Central Power & Light
Kentucky Utilities Co.
Kingdom of Greece
Mississippi Power Co.
Niagara-Mohawk Power Corp.
Ohio Edison Co.
The Ohio Power Co.
Oklahoma Gas & Electric Co.
Philadelphia Electric Co.
Public Service Co. of Colorado
Public Service Company of New Mexico
Public Service Div. of Commonwealth Edison Co.
Soc. Gen. Elec. Della Sicilia
Societa Idroelittrica Peimonte
Societa Meridonale de Electricita
Tampa Electric Co.
Tennessee Valley Authority
Tucson Gas Elec. Lt. & Power Co.
United Illuminating Co.
West Texas Utilities Co.
Wisconsin Power & Light Co.

The Babcock & Wilcox Company, Boiler Division
161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX
BOILER DIVISION

G-635

For more data circle 514 on Post Card

To get the best gasketings for all your requirements...

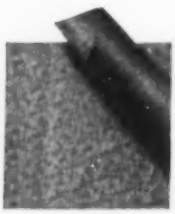
Specify

GARLOCK GASKETS

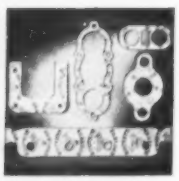
Made from these materials:

- Asbestos, compressed
- Asbestos, metallic
- Asbestos, woven
- Cork-fibre, glycerine treated or synthetic-rubber impregnated
- Leather
- Kel-F†
- Teflon‡
- Natural rubber
- Synthetic rubbers including:
  - Buna-N (Hycar)
  - Butyl
  - GR-S
  - Neoprene
  - Silicone
  - Thiokol
- Vegetable fibre

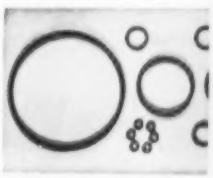
Molded Rubber Gasketing Devices



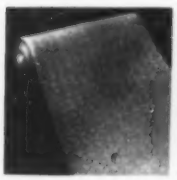
Compressed Asbestos Sheet



Duck Inserted Rubber Gaskets

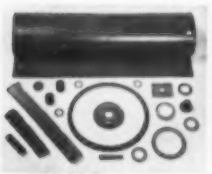


"O" Ring Gaskets



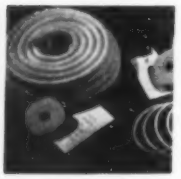
Cork-Fibre Sheet

GUARDIAN* Asbestos-Metallic Gaskets



Silicone Gasketings

"Teflon" Envelope Type Gaskets with Compressible Fillers



Asbestos Tubular Gasketing

*Registered Trademark

There is always *one* type of gasketing material that's best for a particular application. When you call on Garlock, you're sure to get the material you need to meet your specific service requirements. Here's why: Garlock can furnish sheet packing or cut gaskets made from *any* one of the basic gasketing materials. We are *not* limited to a few gasketing specialties.

Therefore, whenever you need gaskets call in your Garlock representative. He can supply you with the type of gasket that will best meet your requirements.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia • Pittsburgh • Portland (Ore.) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

†The Kellogg Company's Trademark

‡Du Pont's Trademark for its Tetrafluoroethylene resin

GARLOCK

PACKINGS, GASKETS, OIL SEALS
MECHANICAL SEALS
RUBBER EXPANSION JOINTS

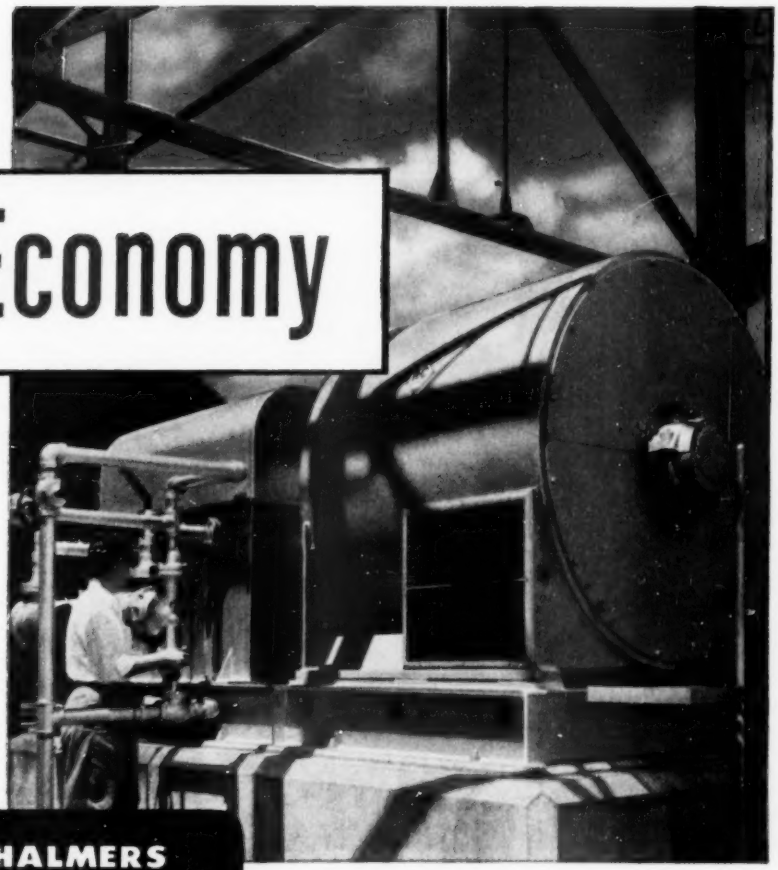
For more data circle 515 on Post Card

3-Way Economy

OPEN SKY is all the roof they need

MAINTENANCE is cut to the minimum

RELIABILITY assures maximum availability



ALLIS-CHALMERS

TEFC MOTORS

Induced-draft fan motor for A-C turbine-generator equipped installation at Georgia Power's Plant McManus is rated 900 hp, 2300 volts, 705 rpm.

WITH Allis-Chalmers *tube-type* totally-enclosed fan-cooled motors, you can cut auxiliary drive costs three ways. The opportunity for low installation cost through outdoor applications is only the beginning. Low maintenance and peak reliability both pay worth-while dividends throughout the long life of these motors.

These savings can be yours because the *tube-type* air-to-air heat exchanger design of Allis-Chalmers TEFC motors offers these advantages:

Complete enclosure protects stator core and other electrical parts from dirt and corrosion — indoors or out — under the most severe ambient conditions.

Self-cleaning action results from generous flow of outside air through smooth, straight, heat-exchanger cooling tubes.

Full internal air circulation provides efficient, even cooling for long, trouble-free insulation life . . . and makes large ratings practical.

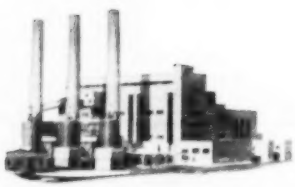
Available in sizes from 40 hp at 600 rpm to the largest required for power plant auxiliaries, this motor design has been proved in operation by hundreds of installations since 1946. For more information ask your A-C representative for Bulletins 51B7149 and 05B7150, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A 4258

ALLIS-CHALMERS

A-C ALLIS CHALMERS

For more data circle 516 on Post Card



Metropolitan Edison Co.
TITUS STATION

Niagara Mohawk Power Corp.
DUNKIRK STATION

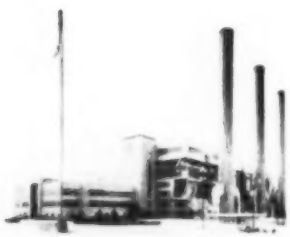
10

Public Service Electric & Gas Co.
SEWAREN GENERATING STATION

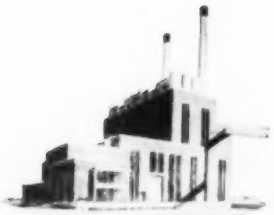
Wisconsin Electric Power Co.
PORT WASHINGTON STATION

Rochester Gas & Electric Corp.
RUSSELL STATION

Tennessee Valley Authority
JOHNSONVILLE STEAM PLANT



Dayton Power & Light Co.
O. H. HUTCHINGS STATION



Cincinnati Gas & Electric Co.
WALTER C. BECKJORD STATION

Central Hudson Gas & Electric Corp.
DANSKAMMER POINT STEAM STATION

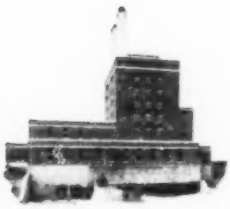
OF THE TOP 15

The annual report of the Federal Power Commission entitled "Steam-Electric Plant Contruction Cost and Annual Production Expenses," covering the year 1952, became available in December, 1953.

Among other interesting and significant data therein were the "Average Btu per Kilowatt-hour Net Generation" rates for 331 power stations reporting from all sections of the country. Ten of the fifteen steam-electric stations having the *lowest* annual heat rates — as revealed by the report — are pictured here.

All the steam generating equipment in these ten stations was designed and built by Combustion Engineering.

B-723A



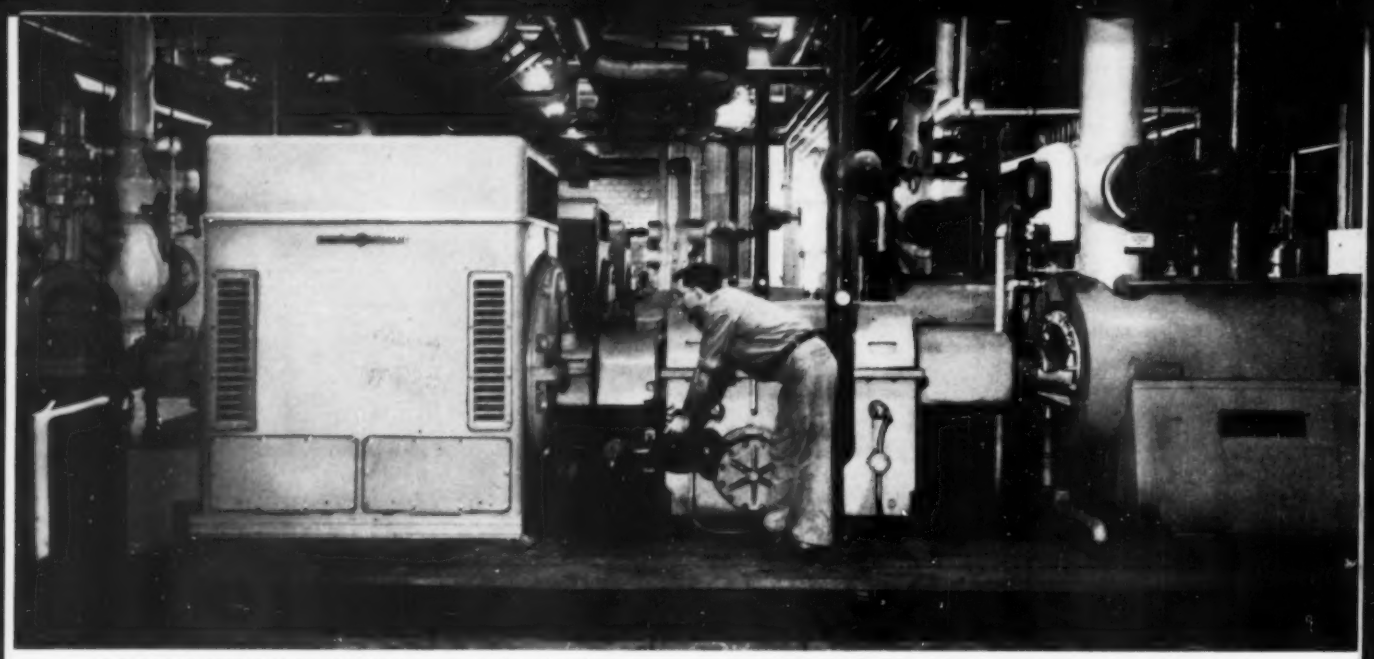
Duke Power Co.
LEE STEAM STATION

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

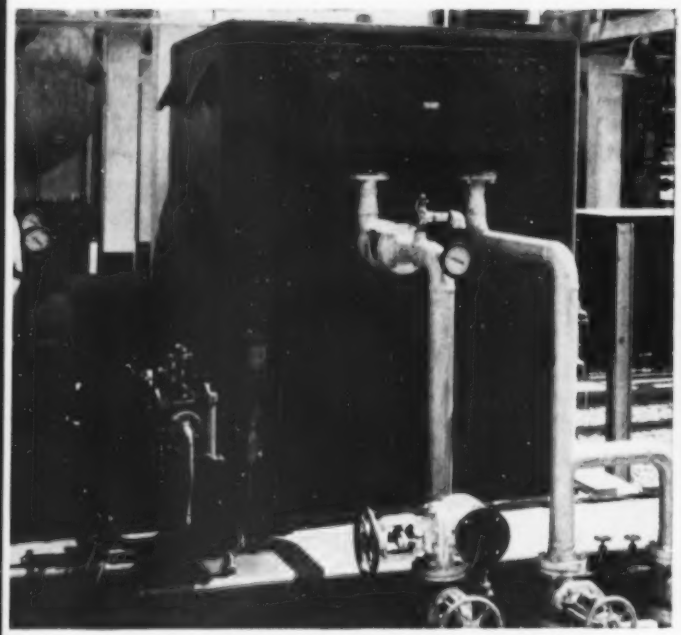
BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

For more data circle 517 on Post Card

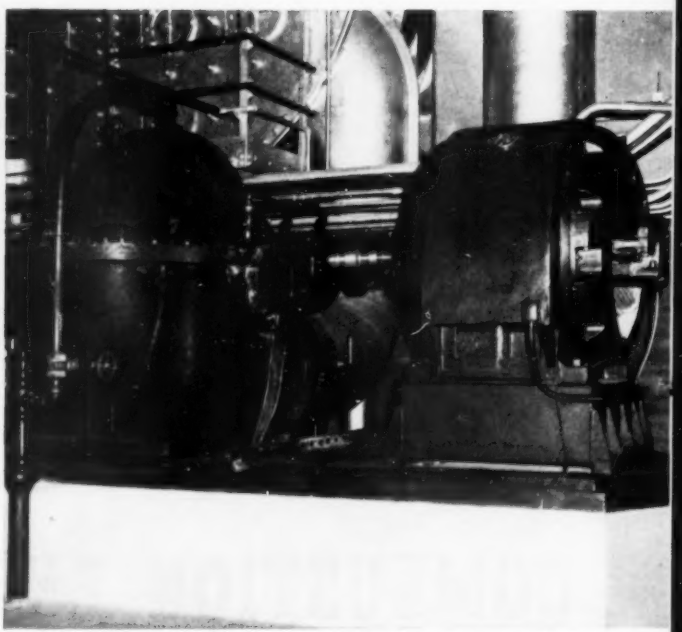


G-E BOILER FEED PUMP MOTORS in a typical application at Detroit Edison's Connor's Creek Plant. Designed especially for boiler feed pump service, 1000 hp ratings and larger, this motor permits closer spacing because of unique ventilating system and cubical shape . . . conserves floor space. You get improved performance from streamlined rotor design which also gives quieter operation. Dual lubrication system combines the advantages of force-flood lubrication and self-lubricated oil rings. Modern appearance blends with power station styling. Write for Bulletin GEA-5813.

Proved Motor Dependability

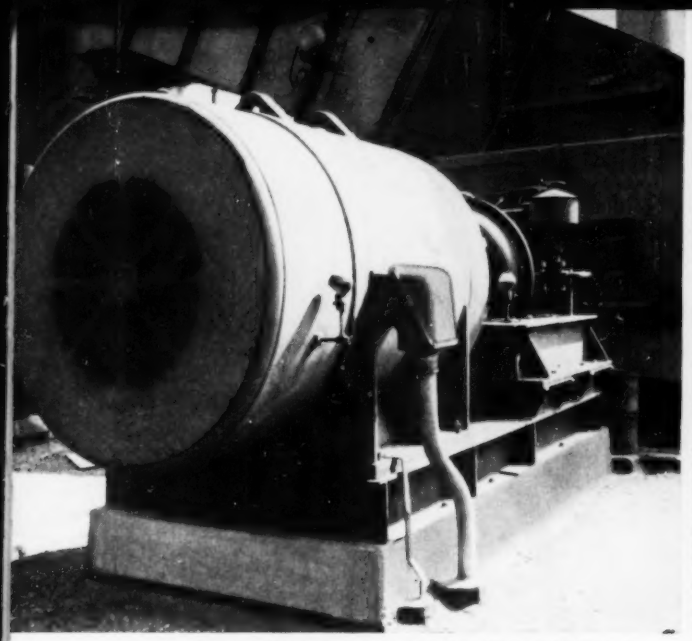


G-E TOTALLY ENCLOSED AIR-WATER COOLED MOTOR is an economical choice for 250 hp and larger. Simple to install, it needs no ducts, filters or blowers. Total enclosure means less maintenance by keeping out dust and other foreign particles. Shown here driving blower in a Kansas plant.

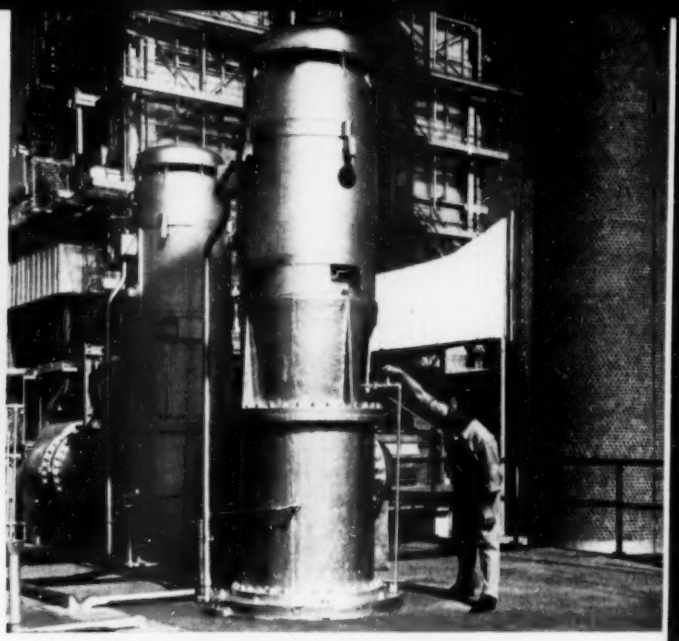


LARGE G-E OPEN DRIPPROOF MOTORS, four or more poles, such as this one coupled to circulating water pump in Cliffside Steam Station of Duke Power Company, are designed for indoor applications only. They are widely used on hot well pumps, forced- and induced-draft fans, and coal pulverizers.

For more data circle 518 on Post Card

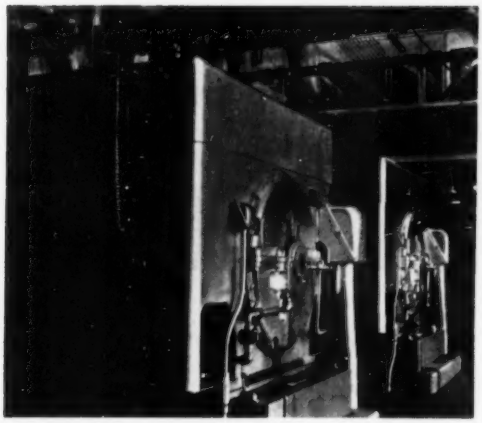


THIS G-E TOTALLY ENCLOSED FAN-COOLED MOTOR drives an induced-draft fan in the Edwardsport Steam-electric Power Station of Public Service Company of Indiana. Total enclosure assures the ultimate in motor protection required for operation in severe atmospheric conditions.



G-E VERTICAL TOTALLY ENCLOSED FAN-COOLED MOTORS, with Tri-Clad* construction, such as these driving pumps at New Orleans Public Service Inc., A. B. Paterson Steam-electric Generating Station, are used for dependable, low-maintenance service in severe ambient conditions.

for Power Station Service



TWO G-E WEATHER PROTECTED MOTORS, grade mounted, driving boiler feed pumps at Florida Power & Light Company's Cutler Plant. Available also in vertical and base ventilated design, this low-cost motor is designed especially for outdoor service where the extra protection of totally enclosed fan-cooled design is not economically justified. Bulletin GEA-5810.

*Reg. Trade-mark of General Electric Co.

G.E.'s complete line of power station auxiliary motors—field proved—assures you of getting the right motor for every operating requirement and station design.

Power stations across the country have installed dependable G-E motors for every auxiliary use. Because of the extensive field study that General Electric has devoted to power station requirements and the engineering experience gained through building all types of power station equipment for over 70 years, you are always assured of getting the right motor for economical and dependable service.

Whatever your needs in power station motors, General Electric can furnish the right type and size from a complete line . . . a wide variety of designs, enclosures, and application variations. You get exactly the motor needed to meet conditions of your operating practice, economics or location.

For more information on G.E.'s complete line of power station auxiliary motors contact your nearest G-E Apparatus Sales Office. *General Electric Co., Schenectady 5, N. Y.* 7356

GENERAL ELECTRIC

custom built systems

HAGAN
automatic
combustion controls

HAGAN
ring balance
instruments

For thirty-five years the leaders in advancing steam production efficiency with Automatic Combustion Control and Instrumentation Systems.

HAGAN
HALL
BUROMIN
CALGON

from standard components

Custom Built from standard components sounds like a contradiction. But it is a fact that each Hagan unit is designed, not only to perform its specific functions efficiently, but also to operate smoothly in combination with other Hagan components. Thus, every Hagan System of Automatic Combustion Control and Instrumentation can be custom built to maintain the exact operating conditions which result in optimum steam production efficiency.

Thirty-five years of experience with all types of boilers, and with every combination of temperature, pressure and fuel system requirements, goes into the design of every Hagan unit and system. As a result, a Hagan System is thoroughly coordinated and easy to calibrate. Adjustments are ample in number and range, so that our engineers—or yours—can get the entire system into accurate operation with a minimum loss of time.

Many of our customers have standardized on Hagan Controls and Instruments for improving existing facilities and for extensions and new construction.

Make Hagan Automatic Combustion Control and Instrumentation the choice for your next installation!

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automotive and Aeronautical Testing Facilities

For more data circle 519 on Post Card

For LOW-COST UPJOHN burns COAL

UPJOHN'S new pharmaceutical plant which includes units for production of penicillin and cortisone, as well as some 700 other pharmaceutical products, relies on coal for dependable steam.

This ultramodern boiler house supplies steam, cleanly and efficiently, at only 40¢ to 42¢ per 1,000 lbs. It delivers 115,000 lbs. per hour at peak load for the Portage Road Plant near Kalamazoo, Michigan.

There are no dust or smoke nuisances, thanks to the dust collecting and cinder re-injection system.

For both efficiency of operation and economy, you just can't beat coal burned the modern way!

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

DEPENDABLE steam, the modern way!

CLEAN, CONVENIENT!

This view of Upjohn's firing aisle shows how clean and convenient coal can be when handled and burned the modern way. The stoker hoppers are fed from an overhead bunker. A 2-ton capacity weigh larry serves all boilers.

The ash handling is fully automatic. Traveling grates continually discharge ashes into hoppers below the floor of the firing aisle.

The 3 boilers shown, plus a fourth recently installed (not illustrated), supply all Upjohn's steam needs.

• Whether you're building a new plant or modernizing an older one, you can count on coal for dependability and low-cost operation.

Here's why: Up-to-date coal-burning equipment can give you 10% to 40% more steam per dollar. Automatic coal- and ash-handling systems can cut your labor cost to a minimum. Let a consulting engineer show you how a modern coal installation, tailored for your specific needs, can save you real money.

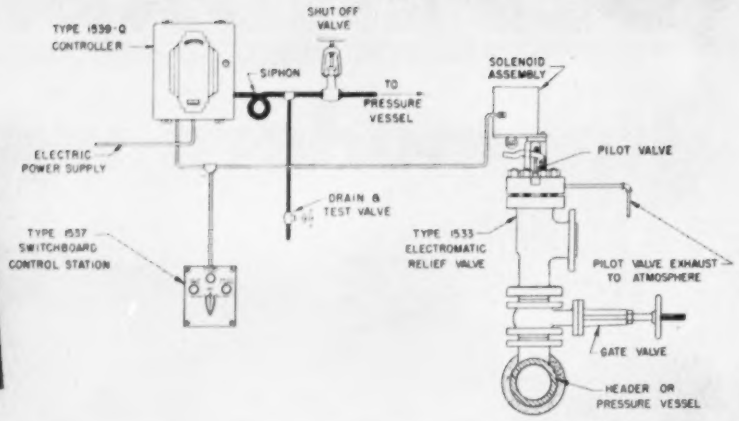
Here's something else, too—of all fuels, coal alone has virtually inexhaustible resources. This, plus the fact that America's coal industry is the most efficient in the world, assures you of a dependable supply of coal at relatively stable prices now and for years to come.

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

For more data circle 520 on Post Card

THIS IS THE CONSOLIDATED ELECTROMATIC RELIEF VALVE SYSTEM



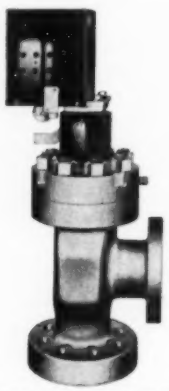
THIS IS WHAT IT GIVES YOU

1. More accurately balanced boiler operation at peak loads.
2. More uniform line pressure.
3. Power conservation.
4. Less maintenance of spring-loaded safety valves.
5. Greater protection against overheating your superheater.
6. Increased efficiency for your steam generating plant.

Automatic, electrically actuated, the Consolidated Electromatic Relief Valve can be set for a differential of 1% or less between opening and closing pressure; relieves pressure precisely within close limits. The valve is operated by a solenoid actuated by a pressure-sensitive element or switch. For automatic or manual service or to cut the valve out of service, just set the switch. Cyclic action is practically instantaneous. Valve operation is not affected by high superheat temperatures or other variables. Manual operation *at any pressure* assures positive circulation through the superheater and greater steam flows during start-up periods than the vent valves normally provide. Danger of burning superheater tubes is minimized under all conditions of service.

You can also use the Consolidated Electromatic as a superheater surge vent or to purge a superheater or header — reduce the possibility of damage to the seats of regular valves and turbine equipment.

Greater efficiency and economy is a "must" in the steam generating plant. That is why the Consolidated Electromatic Relief Valve is important to you. Get complete construction, installation and operating details. Write today for Bulletin 720.



CONSOLIDATED ELECTROMATIC RELIEF VALVE

Sizes:
2½", 4", 10", 14"
Pressures:
Up to 2500 p.s.i.
Temperatures:
Up to 1100° F.
Standard Connections:
A.S.A. flanged and welded.

CONSOLIDATED SAFETY VALVES

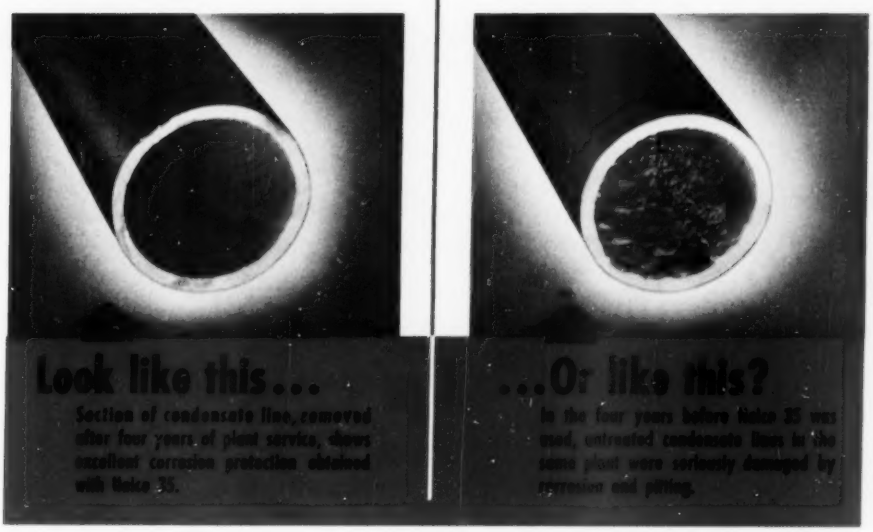
A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For more data circle 521 on Post Card

In the next 4 years...

Will your condensate return lines



Look like this...

Section of condensate line, removed after four years of plant service, shows excellent corrosion protection obtained with Nalco 35.

...Or like this?

In the four years before Nalco 35 was used, untreated condensate lines in the same plant were seriously damaged by corrosion and pitting.

See next page for data on how to keep your condensate return lines clean and corrosion-free . . . permanently.

THE Nalco® SYSTEM...
SERVING INDUSTRY THROUGH PRACTICAL APPLIED SCIENCE

NATIONAL ALUMINATE CORPORATION
6216 W. 66th Place, Chicago 38, Ill.

Send me:

- ☐ Bulletin 35 . . . "Stop Condensate Corrosion in Return Lines, Tanks and Heaters."
- ☐ Reprint 29 . . . "Use of Amines in Low Make-Up Steam Plant."
- ☐ Reprint 30 . . . "Amines for Corrosion Prevention in Steam Condensate Systems."

NAME _____

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COMPANY _____

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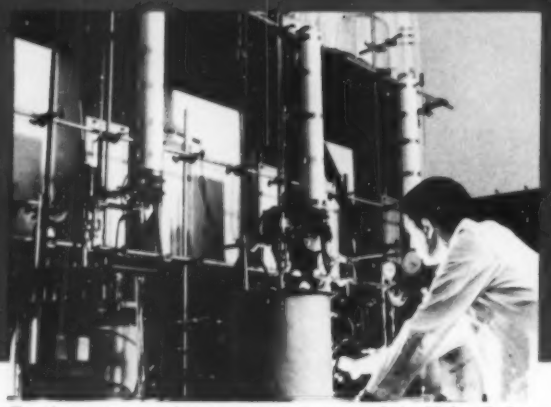
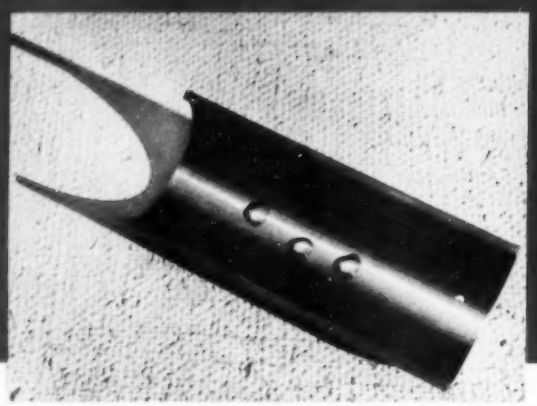
CITY _____ ZONE _____ STATE _____

TWO *Nalco* METHODS FOR POSITIVE CONDENSATE CORROSION PREVENTION



Continuous corrosion-prevention research in Nalco Laboratories has developed outstanding control methods and chemicals for many types of corrosion problems.



Treated with film-forming Nalco 35-FM, this section of condensate pipe shows complete repellence to water droplets. Corrosive condensate never touches metal.

1 *Nalco* 35 PREVENTS CORROSION BY pH CONTROL

Nalco 35 controls pH in the condensate return system . . . neutralizes carbon dioxide to assure corrosion prevention. Especially recommended for low make-up systems, Nalco 35 vaporizes and condenses with the steam, *and at the same rate*. Uniform treatment concentration is assured throughout the system; and long-lasting Nalco 35 makes positive return-line, tank, and valve protection a real operating economy.

2 *Nalco* 35 FM PREVENTS CORROSION BY PROTECTIVE FILM

Nalco 35 FM protects metals in steam systems by forming a tough, rustproof microscopic film on all exposed surfaces. Corrosive gases and liquids cannot reach the metal surface to cause damage.

Nalco 35 FM is fed with a low-cost Nalco condenser-feeder, or any good chemical pump, directly into steam or condensate lines. Once your steam system has protection of Nalco 35 FM film, low dosages maintain film permanently.

***Nalco* WATER TECHS**

Use the postpaid return card to get your copies of up-to-the-minute literature on condensate corrosion control listed on the reverse side of the card.

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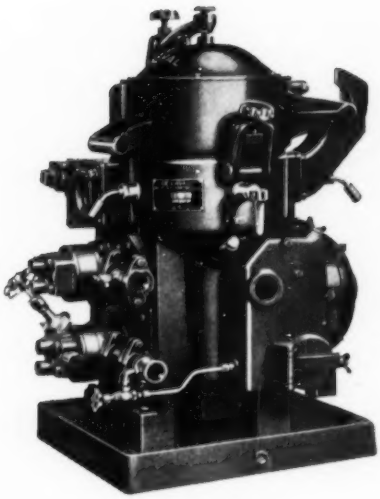
NO GETTING AROUND IT!

A De Laval Centrifuge Costs Much Less Than "Down" Time

The cost of a De Laval Centrifugal Oil Purifier of any given size is only a fraction of the cost of the prime mover it protects. There's no denying it, the comparatively modest investment represented by a De Laval Oil Purifier is far outweighed by the cost of even one serious shutdown. A De Laval machine is truly inexpensive insurance.



A De Laval Oil Purifier instantaneously removes from lube oil, all water, dirt or sludge by means of centrifugal force, keeping the oil clean and safe. The water is discharged continuously. Moreover, every De Laval machine correctly selected for size in the first place, has ample reserve capacity to take care of a sudden water leak.

Naturally, any solid contamination is thrown out of the oil and stored out of the zone in which purification takes place.

De Laval protection is *complete* protection!

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

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For more data circle 523 on Post Card

OIC Valves

...THE MODERN LONG LINE

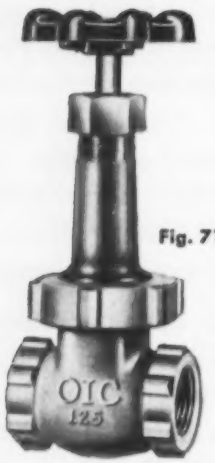

Fig. 7100

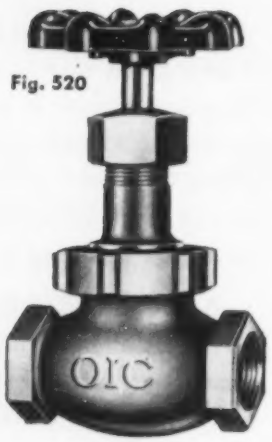

Fig. 520

BRONZE

⅛″ to 3″. 125, 150, 200, 300 and 350 WSP; 300A; 200, 400, 2,000 and 2,500 WOG.

Fig. 516

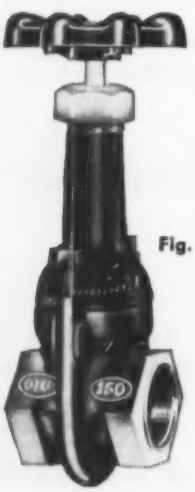

Fig. 333

Fig. 1140

IRON

1¼″ to 16″. 125, 150 and 250 WSP; 175, 200, 400 and 500 WOG. ¼″ to 4″ DUO-BOLT Gates.

Fig. 124

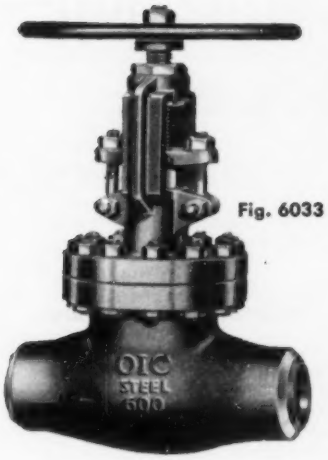

Fig. 6033

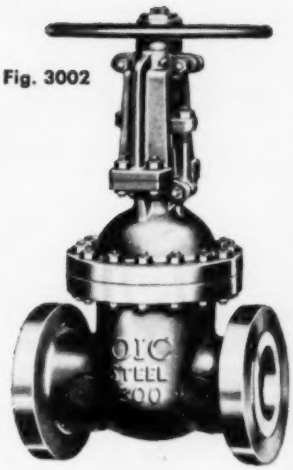

Fig. 3002

CAST STEEL

2″ to 16″. 150, 300 and 600 lb. primary pressure series.

Fig. 1572

FORGED STEEL

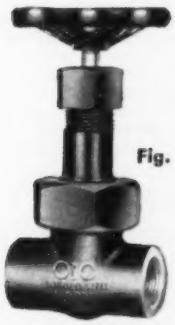

Fig. 1021

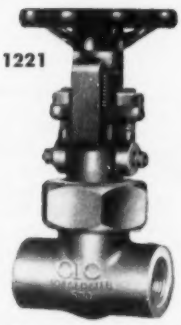

Fig. 1221

¼″ to 2″ Gate, Globe, Angle, Check Valves; 600 lb. primary pressure series.

STAINLESS STEEL

Fig. 810

½″ to 2″. Gate valves, 200 lb. primary pressure series.

Fig. 815

LUBRICATED PLUG

Fig. 10

1″ to 24″. Iron . . . 175 psi to 800 psi working pressures. Cast Steel series 150 lb.-230 psi, 300 lb.-600 psi and ASA 150 lb. class.

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For any splicing or insulating job—
there's a "U. S." Tape

HOLDTITE® FRICTION TAPE

This is the strong, tacky tape that really grips and stays on. The fabric has unusually high tensile strength to handle *any* electrical or general purpose job. Non-ravelling, straight-tearing. No pinholes to cause leaks. U. S. Holdtite exceeds A.S.T.M. Specifications.

HOLDTITE RUBBER TAPE

For durable splices on all general electrical work. Holdtite is an unvulcanized rubber splicing compound with high tensile strength, high elongation and tackiness plus dielectric strength. Electricians like its "feel". Easy to handle, pulls down tight and *fuses* quickly into a solid mass without heat or undue pressure. Insures long-aging splices. U. S. Holdtite exceeds A.S.T.M. Specifications.

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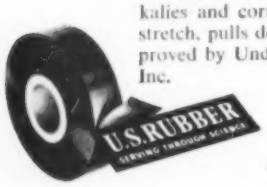

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HELPFUL BULLETINS

BOILERS AND BURNER UNITS

101 Boiler Reference Guide — General Catalog 80, 32 pp, contains latest and most complete data on manufacturer's line of high and low pressure steel boilers for heating, power and process steam. Also includes descriptions of water heating products, both direct fired and storage types, as well as indirect water heating coils. Information on boiler support brackets, structural steel suspension and induced draft fans is provided in this technical manual. Also included are boiler selection table, ratings and dimensional data. Kewanee-Ross Corp.

102 Automatic Boilers — This bulletin describes 17 sizes of Powermaster packaged automatic boilers from 15 through 500 hp for steam process, steam and hot water heating service. Lists such advantages as three-pass design, forced draft and automatic controls. Describes firing equipment for light and heavy oils, gas; shows various fuel firing arrangements. Orr & Sembower, Inc.

103 Burner Unit — Illustrated Bulletin 430 introduces company's Model PK-54 oil, gas, and combination burner designed for fully automatic operation and sized for capacities to 42,000 lb of steam per hour. Stresses adaptability, safety features and performance advantages. Peabody Engineering Corp.

104 Boiler-Burner Units — Illustrated in full color, 16-pp Catalog 1031 describes Kewanee-Ray boiler burner units enabling the selection of the proper unit for any particular application to high or low pressure heating, power or process steam. Discusses outstanding features of the units, and provides ratings, dimensional data. Kewanee-Ross Corp.

ELECTRICAL EQUIPMENT

105 Synchronous Motors — Standard construction features of manufacturer's engine-type, synchronous motors in ratings of 100 hp and larger at speeds of 450 rpm or less are described in Bulletin 05B8008. Stator, rotor and collector assembly features are described and illustrated, also such modifications as extra flywheel effect, split rotor and split stator. Discusses special type construction that can be provided. Allis-Chalmers Mfg. Co.

The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 127-128

106 Control Selection Guide — Late selection information on motor starters and pushbuttons is contained in 6-pp Bulletin GEA-6061. Provides buying information on a-c magnetic motor starters ($\frac{1}{6}$ to 50 hp), a-c combination starters ($\frac{1}{2}$ to 25 hp) pushbutton stations, a-c manual motor starters, and magnetic reversing controllers. In addition to ratings, contains photos of the equipment, circuit diagrams and brief application information for controls. General Electric Co.

107 Data on New Battery — The nickel-cadmium battery, recently made available for civilian use, is described in 20-pp Form SA-98. Stresses compact size, long service life of this sintered-plate type battery which is an alkaline system using a solution of potassium hydroxide as the electrolyte. Discusses construction, principle of operation and characteristics, and includes performance data. Sonotone Corp.

108 High Current Tester — Catalog 154, 4 pp, describes company's Multi-Amp for testing and calibrating electrical protective equipment under operating conditions. Gives general specifications for eight models. Tells of test record cards developed for use with this instrument. Multi-Amp Corp.

109 Outdoor Service Equipment — Designed to facilitate selection of outdoor service equipment, 12-pp Bulletin 2016, combines descriptive data on service entrance, receptacle type, dual control, three-phase units. Typical assemblies of circuit breakers and enclosures are listed for each type of equipment. Also included is guide to company's entire line, giving catalog numbers, hub sizes, voltages, ratings. Bulletin explains hydraulic-magnetic operating principle of manufacturer's circuit breakers, and pictures units available for use in outdoor service equipment. Heinemann Electric Co.

110 Magnetic Contactors — Bulletin 501 and 502, 8 pp, describes company's Noark magnetic contactors, electric switches in which make-and-break action is controlled by electro-magnet and used for resistance loads, or where overload protection is not provided for. Shows NEMA enclosure types available and lists dimensions and weights of available types. Federal Electric Products Co.

111 Instrument Transformers — Publication GEA-4626G is the 96-pp 1954 edition of this company's "Instrument Transformer Buyer's Guide." Fully illustrated, contains ratings, ASA accuracy classifications, and prices of indoor and outdoor potential and current transformers. Listings of ratio and phase-angle tests, together with tables covering mechanical and thermal limits of current transformers, included. Available to qualified power engineers. General Electric Co.

112 Tautline Cableways — General Catalog Section G, 16 pp, describes, with photos and sketches, the types, spans, working loads and other details of tautline cableways. Illustrates cableway applications. Sauerman Bros., Inc.

COMMUNICATION

113 For Selective Calling — Detailed information on selective calling equipment for individually controlling radio-equipped vehicles is given in this illustrated bulletin. Describes both the pushbutton type and the economical dial-operated control units, includes specifications. The Hammarlund Mfg. Co.

114 Industrial Television — Advantages of manufacturer's industrial television, as given in Bulletin 2J8837, 8 pp, are accuracy, operating simplicity, and safety and convenience. Describes, illustrates the two units — camera and control monitor — which make up the industrial TV chain. Discusses accessory equipment for special applications, and gives planning, installation and service information. Radio Corp. of America.

VALVES, TRAPS, PIPING AND FITTINGS

115 Controlled Closing Valve — This 6-pp brochure describes a valve designed to counteract problems of surge and water hammer in pipe lines. Outline drawings of the unit, as well as a description of its primary purpose, design characteristics, operation and supplemental uses are provided. Simplex Valve & Meter Co.

116 Relief Valves — Bulletin 297 is a 16-pp handbook explaining and illustrating function of temperature and pressure relief valves for water heaters. Discusses AGA and ASME code requirements; presents recommended code requirements for cities, inspectors and plumbers. Lists 25 "do's and don'ts" for valve users. A. W. Cash Valve Mfg. Corp.

117 How to Use Valves — "Getting the Most Out of Your Valves," is an 8-pp booklet on valve selection and use. Covers the selection of valve types and materials, installation and operation hints, and includes inspection and maintenance pointers. The Cooper Alloy Foundry Co.

118 Steam Traps — Bulletin 1153 shows operators of steam-using units how to heat them up eight times faster with manufacturer's Super-Silvertop Heat-Kwik steam traps. Stresses more production, lower steam consumption, longer trap life and reduction in trap capacity factor. Contains buying data including condensate capacities. The V. D. Anderson Co.

119 Aluminum Pipe, Fittings — Twelve-pp Form AD-197 shows by text and picture where aluminum pipe and fittings are used and why manufacturer's own aluminum pipe offers special advantages. Also lists gases and liquids which can and cannot be safely carried by aluminum pipe, and gives tips on installation. Includes properties of aluminum pipe alloys, dimensional and pressure data. Aluminum Co. of America.

120 Glass Pipe, Fittings — In addition to introducing a new line of sink traps and some new fittings, this 20-pp catalog also lists standard items of stock lengths that are available. Physical properties of Pyrex glass pipe that suggest its use for processing industries are discussed, as are ease of cleaning and installation and economy of operation and maintenance. Technical data and specifications on Pyrex brand spacers, adjustable joints, stock valves, included. Typical installations are shown. Corning Glass Works.

121 Pipe Insulation — Mono-Kover, a lightweight one-piece pipe insulation, is described in this bulletin. Photos show how easily it is applied, and text covers its thermal resistance, permanence, resiliency, non-corrosive properties and lower applied cost. Also included are a thermal efficiency chart, insulation thickness selection table, and sizes, thicknesses. Baldwin-Hill Co.

122 Expansion Compensator — Bulletin 138 describes briefly the Flexon expansion compensator for controlling pipe expansion in low pressure hot water or steam heating systems. Tells how compensator serves to prevent pipe creepage, how it works, special advantages. Includes installation tips. Flexonics Corp.

123 Facts on Purifiers — Eight-pp Bulletin 700 shows how manufacturer's Hi-eF purifiers can cut costs by eliminating moisture, dirt and entrainment from live steam, exhaust steam, compressed air and gases and vapor. Covers application of these purifiers in steam generation and distribution equipment, in the chemical industries, in petroleum refining and in food processing. The V. D. Anderson Co.

124 Tube Fittings — Catalog 1253, 16 pp, illustrates and lists prices on brass shut-off valves; S.A.E. flare tube fittings; compression, brass pipe, iron pipe and automotive fittings. Also covers uni-seal range connectors, and copper tube tools, trailer fittings, globe and angle valves. Universal Brass Corp.

FLEXIBLE TUBING, HOSE

125 Tips on Hose Care — This little booklet gives simple hints, amusingly illustrated, on use, care and maintenance of rubber hose. Lists do's and don'ts to make installation easy. Hewitt Rubber Div., Hewitt-Robins Inc.

126 Flexible Tubing — "Flexineering", an application of flexible tubing for air, oil, steam, gases and volatiles, is explained in this eight-pp data book. Illustrates company's steel, bronze and aluminum tubing; blower and ventilation hose; tar and asphalt hose; diesel piping. Gives engineering data on all manufacturer's tubings and couplings. Pennsylvania Flexible Metallic Tubing Co.

INSTRUMENTS AND CONTROLS

130 Measuring Flow and Liquid Level — Bulletin 1160, 24 pp, describes 12 systems for measuring and controlling liquid level. Contains brief sections on measurement, remote transmission and automatic control; tells how to handle corrosive, volatile and other difficult liquids. Two-pp tabulation of the systems compares application, components, principles of operations, range, advantages and limitations, references. Industrial Div., Minneapolis-Honeywell Regulator Co.

131 Process Control Instruments — Bulletin F-5633-1 describes and pictures a line of instruments for process control applications. Of special interest is a discussion of company's electronic link, a simple no-contact linkage between the precision, direct measuring unit and the automatic control and recording system. Also discusses combustion safeguards. Wheelco Instruments Div., Barber-Colman Co.

132 Data on Circuitry — Bulletin 112, 8 pp, explains functioning of 11 control and alarm circuits utilizing meter-relays. Describes circuits for battery charging control, null-balance pulsing, over- or under-voltage or current alarm, temperature control. Discusses principles of operation of meter-relays and some limitations on their use. With each control diagram, are listed components for use in circuit, and also plug-in assemblies from which the controls can be made. Assembly Products, Inc.

133 Resistance Thermometer Bulbs — Catalog 5701, 16 pp, describes resistance thermometer bulbs of high speed, marine, room temperature and sanitary types, for temperature spans as narrow as 20 F. Includes wet and dry bulb resistance thermometer assemblies for measuring humidity. Industrial Div., Minneapolis-Honeywell Regulator Co.

134 Hot Water Controls — Company's electronic controls for hot water heating systems are described in Bulletin F 6167, 8 pp. Discusses simple operation of electronic outdoor reset hot water controls; use of optional night depression feature. Barber-Colman Co.

137 Time Delay Relays — Solenoid-actuated, pneumatically-controlled time delay relays are described in Bulletin SR-3. Presents two basic types; one in which time delay begins when coil is energized and one, with time delay beginning when coil is de-energized. Includes mounting dimensions and wiring diagrams. Elastic Stop Nut Corp. of America.

138 Dynamometers — Bulletin DB-1, 16 pp, illustrates and describes a line of eddy-current Dynamatic dynamometers, accessories and controls. Includes operating photos, engineering drawings, graphs, tables on typical installations. Dynamatic Div., Eaton Mfg. Co.

PUMPS AND COMPRESSORS

139 Chemical Pumps — Twelve-pp Bulletin P-1153 describes simplex and duplex reciprocating plunger pumps for pressures to 20,000 lb and capacities from a few cc per minute to over 900 gph. Includes information on standard stainless steel, spring-loaded double ball-check valve as well as company's Saf-T-Kleen valve for slurries, corrosives food products. Design and structural advantages of the pumps are outlined. Philadelphia Pump and Machinery Co.

140 Fire Pumps — Bulletin W-450-B42, on vertical turbine fire pumps, describes and gives specifications on these pumps designed for industrial installations. Shows how they provide an adequate defense for plants in areas where primary water supply is limited or there is no municipal water supply. Worthington Corp.

141 Sump Pumps — Construction details, head and capacity tables, dimensions, for company's Unit-Line sump pumps (a pre-engineered packaged line from which the required pump can be selected), are provided in 8-pp, fully illustrated Bulletin 1029. Johnston Pump Co.

142 Packaged Feed Systems — Bulletin T-1153 outlines "packaged" chemical feed systems for water treating applications and other chemical single and partitioned tanks, equipped with simplex or duplex pumps for feeding one or two chemicals in correct proportion. Philadelphia Pump and Machinery Corp.

143 Compressor Lubrication Problems — Vol. 40, No. 1 of Lubrication provides a 14-pp article on problems associated with compressor lubrication. Reviews compressor types, function of the lubricant and importance of adequate installation. Air compressor explosions and receiver fires are discussed, as are condensation and compressor cooling, bearing lubrication, selection of lubrications. Special problems of air, gas, refrigerator, and other compressors are treated. Includes lists of factors which control dependable compressor operation, and those which may react against efficiency. The Texas Co.

WATER TREATING

144 Acid Adsorbent Resin — Acid adsorption with Duolite A-7, a low cost anion exchange resin, is discussed in detail in this 20-pp booklet. Covers porosity, thermal stability, other properties; regeneration; rinsing problems; physical considerations; other pertinent subjects. Includes standard data for water deionization. Chemical Process Co.

145 Deaerating Heater — Publication 4643 describes manufacturer's Uni-

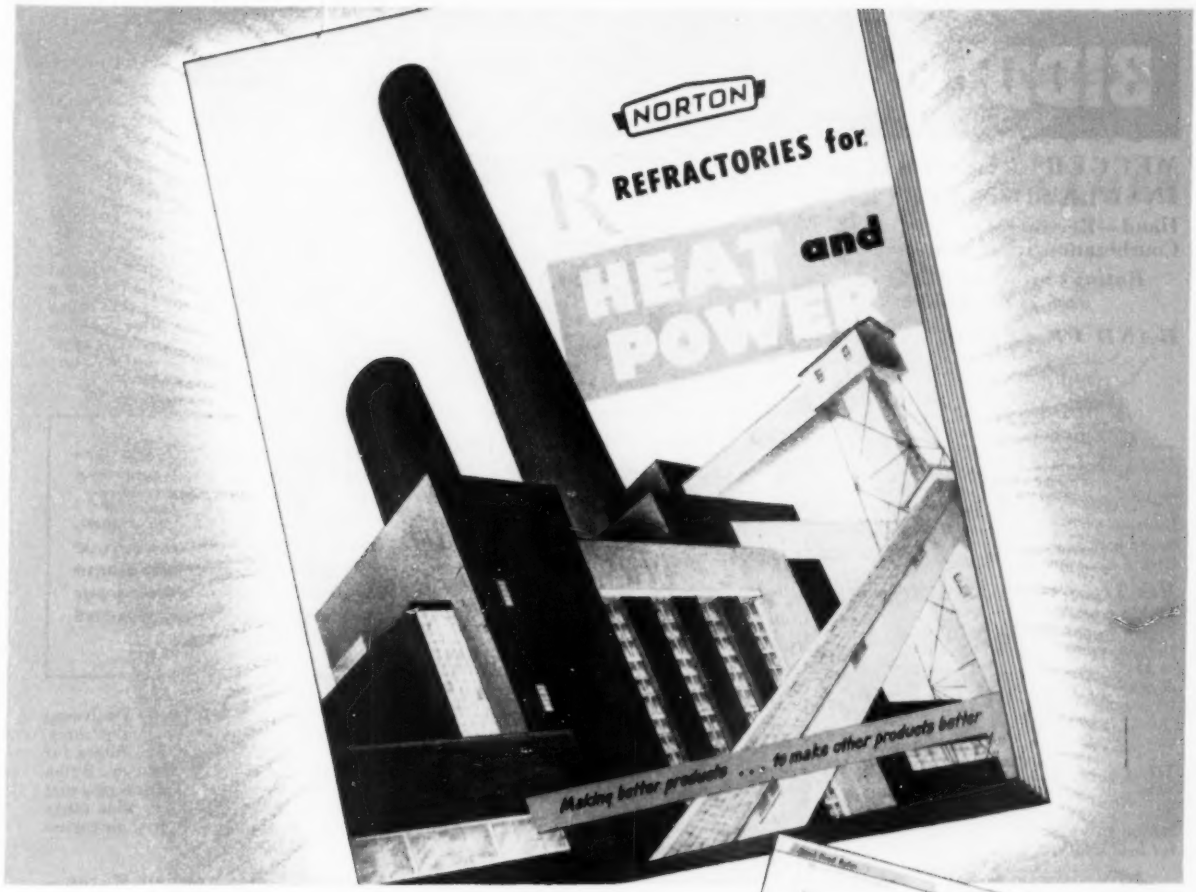
. . . *Outstanding Among This Month's Catalogs* . . .

128 Pipe and Coil Data Book — A 40-pp engineering data book, Form 1053, gives information on design and calculation of pipe and fin coils, heat transfer coefficients for heating and cooling. Discusses factors for computing fin coil surfaces, recommended materials for heating or cooling, heat transfer factors at various air velocities and Btu load limitations for cooling coil circuits. Available to qualified power engineers, please state your title. Rempe Co.

129 Remote Bulb Thermometers — Catalog 6709, 44 pp., in describing remote bulb thermometers — covers recorders and indicators, pneumatic control, electric control, program control, psychrometers, bulbs, tubing and fittings. Gives chart and scale selection data, dimensions of instruments. Includes ordering data. Industrial Div., Minneapolis-Honeywell Regulator Co.

135 Industrial Products Guide — Newest edition of this company's industrial products catalog is a 40-pp book offering essential data on insulations, refractory products, asbestos cement pipe, packings, gaskets, electrical products, frictional materials, and others. Photos, diagrams, and text have been revised and brought up-to-date to provide the latest information on these products. Johns-Manville.

136 Cooling Tower Wood — CTI Bulletin TSC-302 is a 16-pp illustrated summary report on deterioration of redwood in cooling towers, by members of the Cooling Tower Institute and California Redwood Association. Classifies types of deterioration, gives maintenance procedure and control of deterioration. Discusses value of proper water treatment in prolonging the service life of the cooling tower. Cooling Tower Institute.



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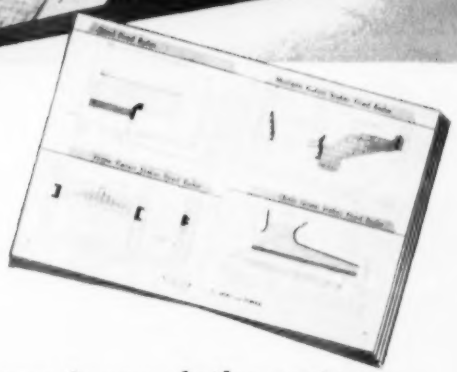

A basic guide to more efficiency and economy in your boiler settings

Compiled to help you solve refractory problems affecting boiler operations, this new Norton booklet is now ready for immediate mailing to your plant.

Here you'll find 32 pages of easy-to-read, money-saving facts, together with explanatory charts, diagrams and photographs describing the many uses and advantages of Norton CRYSTOLON* refractories for heat and power applications.

The right Rx *for every boiler need*

This booklet gives you full information on the best protection for water tubes; for the construction of air-cooled and solid walls; on laying bricks and making general repairs; on the correct refractories to use for every type of boiler. The properties of various refractories are thoroughly described and there are handy quick-figuring charts for temperature conversion, boiler efficiency, etc.

Remember, these refractories are *engineered and prescribed* by Norton to save you time and money in your heat and power requirements. This booklet tells you how. Send for your copy today. NORTON COMPANY, 612 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto 5, Ontario.

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NORTON REFRACTORIES

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Making better products . . . to make other products better

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BIDDLE *Instrument News*

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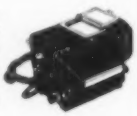
Hand—Rectifier—or Combination Operation—

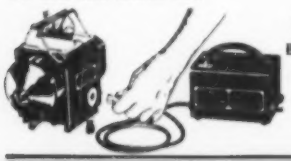
Ratings up to 2000 Megohms and 1000 Volts D-C

HAND CRANK MEG TYPE of Megger Insulation Tester is a reliable field instrument, light, sturdy, with a constant-voltage type generator—no dependence on batteries or other current supply. By far the most popular instrument among electrical plant maintenance men. Easy to use—easy to read—and rugged in constant services.

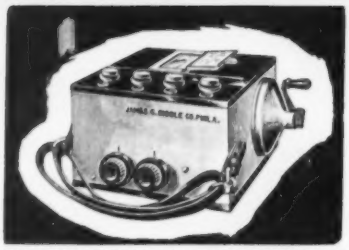
RECTIFIER OPERATED Meg Type of Megger Insulation Tester simply plugs into a convenient outlet. Portable or flush bench-mounted. A dependable production or inspection instrument. Quick, easy readings speed up otherwise costly tests.



DUAL-OPERATED MEG TYPE of Megger Insulation Tester may be operated by hand or rectifier. Excellent solution for those requiring a versatile instrument for field and bench use.



Write for BULLETINS 21-45 PE 21-46 PE



INSULATION TESTER & WHEATSTONE BRIDGE in ONE EASILY PORTABLE INSTRUMENT

Measures Electrical Resistances From a Fraction of an Ohm up to 1000 Megohms

Affords the facility of:

- **A Wheatstone Bridge** for measuring conductor resistance of coils, resistors and circuits.
- **A Megger Direct Reading Ohmmeter** for measuring electrical insulation resistance (ohm and megohm scales).
- **A Varley Loop Feature** for locating faults on wires (optional).

This Bridge-Meg weighs only 15 lbs. and is completely self-contained with its own constant-voltage generator—no need to be dependent on batteries or other suitable test current.

Why burden yourself with two instruments when you can have the facilities of two for little more than the price of one in one compact, sturdy case. For complete details and prices write for BULLETIN 21-60 PE.

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Average Measuring RPM or FPM Jagabi® Speed Indicator

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B-914

Frahm® Resonant Reed Tachometer

Quick Accurate Readings with Safety

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JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

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For more data circle 527 on Post Card

Pac deaerating heater designed for small and medium size power plants. Explains how deaerator is self-contained and factory assembled for easy installation on a variety of storage tank sizes. Describes operation, design, storage capacities and advantages. Cochrane Corp.

FILTERING EQUIPMENT

146 Pressure-Leaf Filters — Catalog NC-1-53, 20 pp, fully illustrated, describes company's Niagara pressure-leaf horizontal and vertical filters for liquid clarification and solids recovery, including new type "H" horizontal filter. Diagrams and charts show operation, sizes, capacities. Discusses time and money savings from use of filters. Niagara Filters Div., American Machine and Metals, Inc.

Postage-free cards for ordering these catalogs are provided on pages 127-128. When using them, don't forget to include your job title and company name —even if you want your catalogs to be delivered to your home address

147 Automatic Filters — Twelve-pp Bulletin 500 describes and illustrates, company's Staynew automatic filters for large air volume and high efficiency. Bulletin contains specifications, engineering and performance data on filters in wide range of sizes for handling any desired air capacity. Dollinger Corp.

148 Oil-Contaminated Water — Power engineers faced with oil-contaminated water problems are offered 8-pp Brochure FA-46A which discusses removal of emulsified oil from condensate or process water by Sorbo-Cel, a specially-treated Celite diatomite filter aid. Describes types of filters used and gives step-by-step directions on operation of filtration system. Johns-Manville.

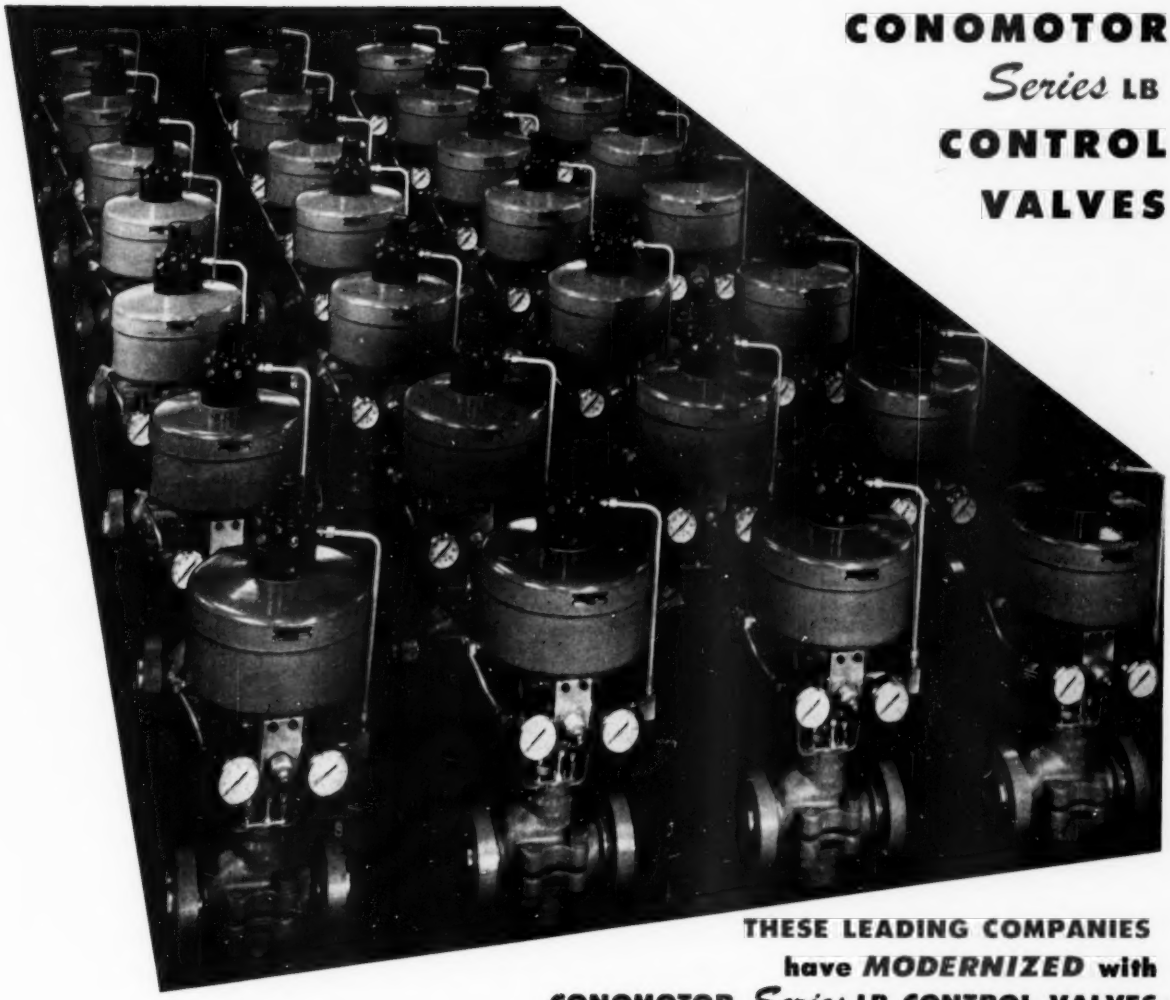
MECHANICAL POWER TRANSMISSION

149 Gearmotor Adaptation — Bulletin B-6090, 8 pp, describes company's integral-type Motocylinder for material-handling applications. The Motocylinder is described as an adaptation of a gearmotor, utilizing a high-torque, high-slip electric motor and a short crank on the output shaft to transform rotary to reciprocating motion. Tells how unit can be employed to flip, turn, release, raise or lower material in repetitive cycles. Gives ratings and characteristics, describes operational and maintenance features. Westinghouse Electric Corp.

150 Flexible Couplings — Sizes and types of flexible couplings for practically every service are presented in 20-pp Form 1009. Fully illustrated, this catalog provides design details, application suggestions and specifications and dimensions. Includes pulsating load and horsepower to torque conversion tables. Lovejoy Flexible Coupling Co.

151 Steel Couplings — Bulletin 4100, 32 pp, provides engineering data covering the selection and application of company's standard Steelflex couplings. Large cut-

CONOMOTOR *Series* LB CONTROL VALVES



THESE LEADING COMPANIES have *MODERNIZED* with CONOMOTOR *Series* LB CONTROL VALVES

Progress cannot be denied! Naugatuck Chemical Division of U. S. Rubber Company has completely equipped a new plant with Conomotor Series LB Control Valves for temperature control on reactors. U. S. Steel is using a large quantity of these valves for various services in their new coal chemical facilities in the midwest. E. I. du Pont use Conomotor Control Valves for their complete valve equipment in a new pilot plant at their Eastern Regional Laboratories. Armstrong Cork Co. has standardized on Conomotor LB Valves for an extensive modernization program. These important decisions were based on thorough evaluation of design, performance and cost. When companies of this caliber approve and adopt a new advance in process control, you can rely on their judgment. These and other new installations are typical of the important part Conoflow final control elements play in the modern industrial evolution to automatic control. Whether you have a new plant or plan to modernize your old plant it will pay you to talk to Conoflow.

- Armstrong Cork Co.
- Bakelite Company
- Colgate-Palmolive Co.
- Curtiss-Wright Corp.
- E. I. du Pont de Nemours & Co., Inc.
- Emery Industries, Inc.
- General Electric Co.
- Heyden Chemical Corp.
- Naugatuck Chemical Division U. S. Rubber Co.
- Philadelphia Electric Co.
- Publicker Industries, Inc.
- Jos. Schlitz Brewing Co.
- Sharples Corp.
- The Sherwin-Williams Co.
- U. S. Steel Corp.
- Victor Chemical Works
- Westinghouse Electric Corp.

WRITE FOR CATALOG LB-1, "PORTENT OF THINGS TO COME"

CONOFLOW CORPORATION

FOREMOST MANUFACTURERS OF FINAL CONTROL ELEMENTS

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WHY INSULATE YOUR CONDENSER TUBES?

You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere—and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in make-up or cooling water.

CD-37

WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

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away illustration shows construction features of these couplings which are designed to accommodate parallel and angular misalignment and free end float. Photos show industrial installations of these couplings. Book also lists brakewheel, controlled torque, high speed and other couplings for special applications. The Falk Corp.

152 Needle Bearings — Catalog 61, 30 pp, describing manufacturer's heavy duty needle bearings, contains helpful selection data. Includes cross-section drawings of typical installations. Lists speed and life factors and capacities; hardness factors; dimensions of bearing assemblies. Presents inner races and housing and shaft fits. The Torrington Co.

153 Self-lubricating Bushings — Eight-pp Bulletin Form 112 discusses company's Graphalloy bushings, designed for strength and high heat dissipating qualities. Also discusses such advantages as durability, no fumes, low and high temperature operation, fire preventive and low coefficient of expansion. Presents engineering data, grades of Graphalloy, and physical characteristics of the metal. Graphite Metallizing Corp.

OTHER EQUIPMENT

154 Dowtherm Vaporizers — Bulletin A-100, 28 pp, offers data on Dowtherm vaporizers and heaters for high temperature, low pressure vapor and liquid phase process heating. Gives operating advantages and explains nine basic systems used for most Dowtherm heating jobs. Photos cover some 30 typical installations and a large cutaway shows design features of an automatic packaged horizontal vaporizer. Other units are also covered. Eclipse Fuel Engineering Co.

155 Mechanical Leather — How Conpor treatments overcome porosity in leather to make it a desirable oil seal or hydraulic packing material is told in an 8-pp bulletin. Flexibility, insolubility in oil and heat stability are stressed. Discusses Conpor K-200 series modifications. Graphs show long life of consistently low leakage that may be expected from Conpor K-200 seals. Chicago Rawhide Co.

156 Dust Collection — Aerodyne dust collectors in chemical processing and other industries are discussed in 8-pp Bulletin 171. Explains theory and design of collector system, includes drawings of the various types covered. The Green Fuel Economizer Co., Inc.

157 Specialized Scale Removal — This bulletin explains company's method of removing scale from water and gas lines with liquid cleaning solvents. Cites cleaning of oil refinery's waterlines in 38 hours with minimum service interruption, and without need of digging up buried lines. Dowell Inc.

158 Emulsion Cleaners — Form A-106 describes emulsion cleaners for removing grease and oil from metals and machinery. These cleaners are added in small amounts to petroleum solvents to increase the penetrating power of the solvent, speed cleaning and improve rinsing. Bulletin explains how cleaners afford a simple, economical method of cleaning and provides chart showing applications for each of seven types. Includes detailed data sheet on each type. Turco Products, Inc.

159 For Fire Protection — Fire extinguishing systems and equipment are

STEAM COST REDUCED

At Chemical Plant with Detroit RotoGrate Stoker!

Write for this coal saving reprint. No obligation.

Handling High Peaks at Low Cost in Coal Fired Virginia Plant

American Cyanamid Company
Calco Chemical Division—Piney River, Virginia

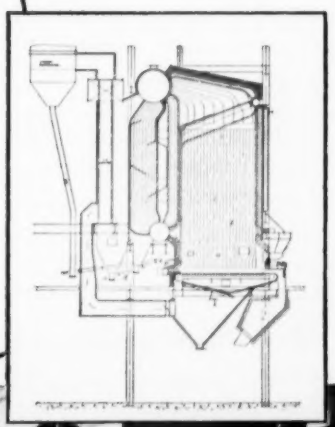
By **C. A. Reed**, Director of Engineering, National Coal Association
Photographs by Clifford H. Adams, Staff Photographer, Bituminous Coal Institute

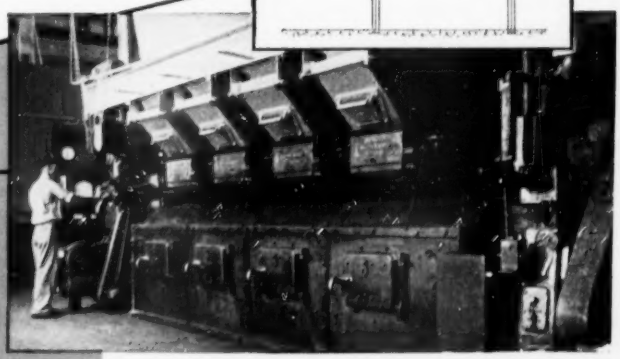
Operating record of this Virginia plant confirms design estimate of 85 per cent efficiency. Steam costs were lowered to 65 cents per thousand, including depreciation, operation, and maintenance.

REPRINTED FROM SOUTHERN POWER & INDUSTRY

Compliments of DETROIT STOKER COMPANY, Detroit, Michigan

Sudden load surges from 50,000 to 90,000 pounds of steam per hour easily handled. Detroit RotoGrate with Riley two drum steam generator. Air preheated to 310° to 345° F.





DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

General Motors Bldg. • Detroit 2, Mich.

Works at Monroe, Mich. • District Offices in Principal Cities

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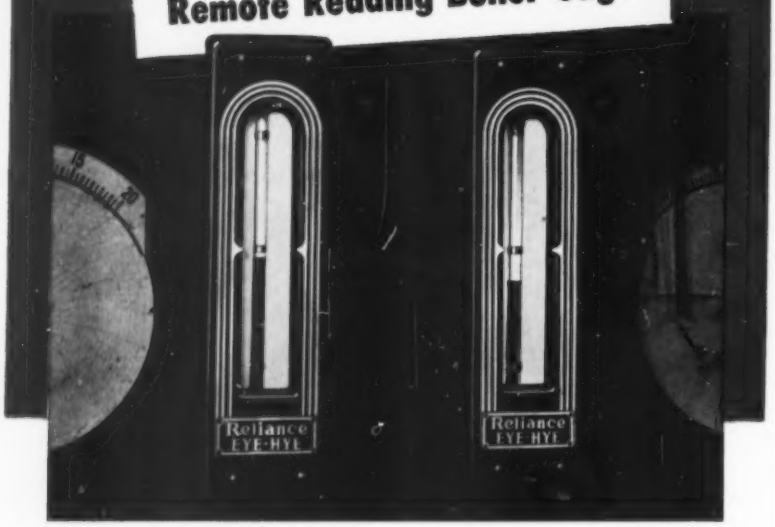
EYE-HYEs on your panel . . .
safe, sure check on water levels

The Reliance-made Hydrostatic Remote Reading Boiler Gage



Easy to Install • Easy to Read • Easy to Maintain

Read your boiler water levels easily, quickly, accurately. Read them *conveniently*, right before your eyes, on panel or wall. You'll read them *oftener* and have better water level supervision. The bright green indicating fluid duplicates the water in your drum gage.

EYE-HYE is simple, safe, sure. It's sensitive to slightest level changes. Has no mechanical parts — is completely hydrostatic. You can blow it down — and should, at intervals, according to instructions. Otherwise practically no maintenance. Models available for pressures to 2500 psi.

Thousands of users have "repeated" — have ordered EYE-HYEs for new boilers, tanks, heaters, etc. Get the full basic story — write for Bulletin CO.

New Illumination for EYE-HYE ▸

EYE-HYE has always been self-illuminated, with incandescent lamps. *Now* a fluorescent tube assures even lighting the entire length of the gage window. The fluorescent unit is available separately for installation in all but very old EYE-HYE models in use. Write for prices — mention the model number on name plate.

THE RELIANCE GAUGE COLUMN CO. • 5902 Carnegie Avenue, Cleveland 3, Ohio

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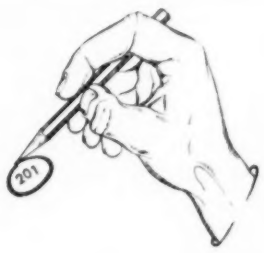
described in 20-pp illustrated Folio 1-1, along with an analysis of causes of extensive fire damage, and the need for specialized protection. Cites examples of adequate protection in typical industries and gives case histories showing how good fire-protection equipment averted serious fire damage. Cardox Corp.

160 Stainless Steel Tubing — Bulletin S-222 describes seamless and welded stainless steel tubes, along with their advantages and applications. Gives thicknesses, typical analyses, standard tolerances, technical and fabricating data; includes workability chart. Globe Steel Tubes Co.

161 Cork Products — Bulletin S-54 gives physical characteristics and uses for both natural cork and cork compositions. Lists government and SAE-ASTM equivalents of manufacturer's cork compositions, also sheet sizes and thicknesses. Dodge Cork Co., Inc.

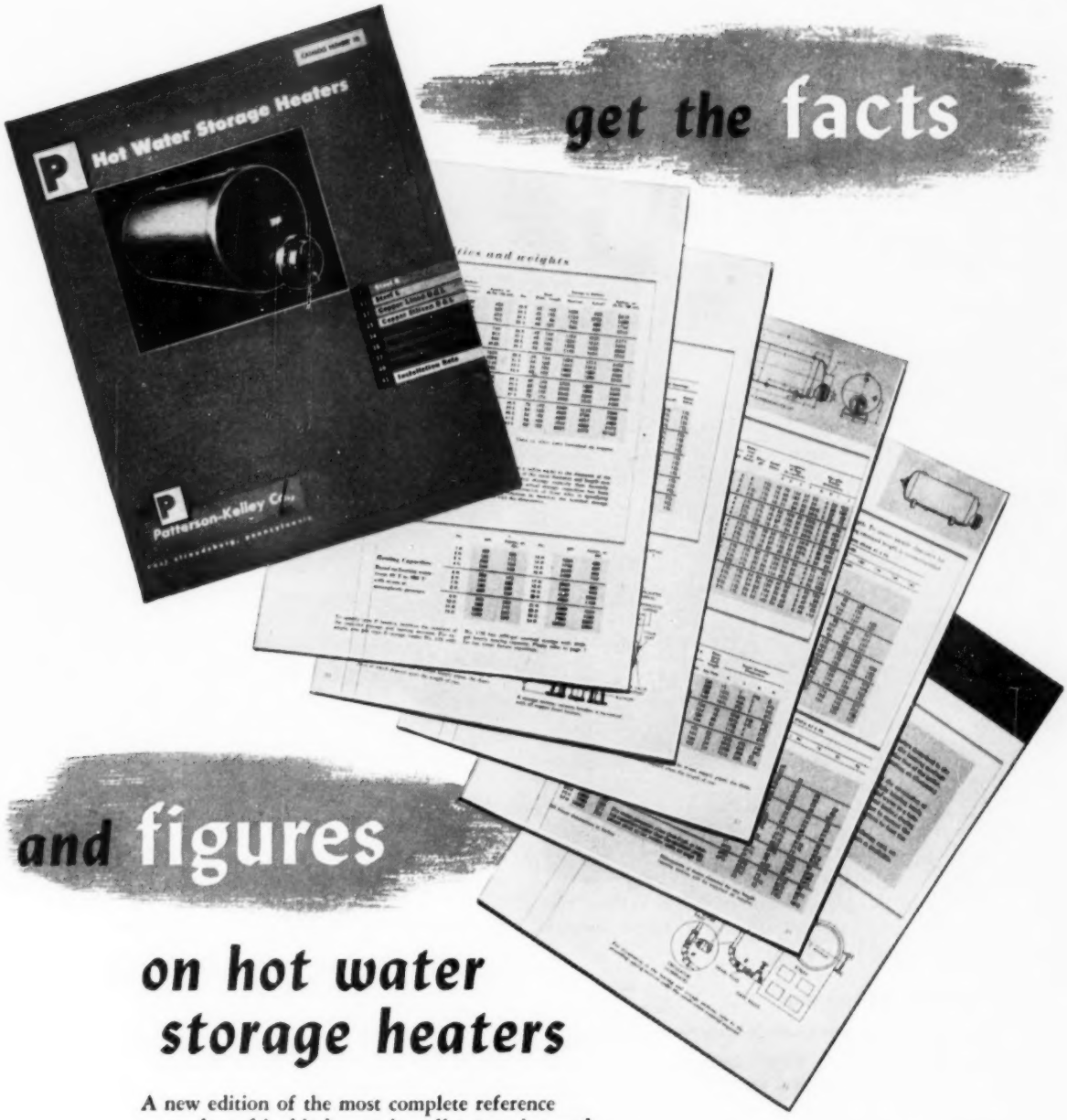
162 Oil Cooling Equipment — Catalog FB-1052, 20 pp, discusses controlled quench oil cooling for uniform quality in heat-treated metals. Describes and illustrates typical installations of coolers; tells how to select cooling systems; gives circulation rates. Charts show oil recirculation for batch quenching, determination of amounts of oil required. Illustrates accessories including Kleen-Well oil strainers, Perambulator oil coolers, junior quencher, centrifugal pumps. Bell & Gossett Co.



It's easy to get these free catalogs—just circle item numbers of those wanted on the two post cards provided on pages 127-128. You may also use the cards to ask for information on the advertised products

163 Water Columns — Data Unit 232 describes, illustrates, and gives specifications on water columns. Principle of operation and features that assure positive alarm signals if boiler water falls too low or rises too high are explained. Jerguson Gage & Valve Co.

164 Forgings and Castings — Smooth hammered forgings, composite die sections and cast-to-shape tool steels are described in this 28-pp handbook. Covers forged shapes available, stainless and tool steel, and weight limits, as well as analyses. Tells how to use and order composite die sections and includes diagrams of standard shapes. Also provided are a guide to the uses and types of cast-to-shape tool steels, and chemical analyses and heat treating instructions for common grades. Allegheny Ludlum Steel Corp.



get the facts

and figures

on hot water storage heaters

A new edition of the most complete reference catalog of its kind, covering all types, sizes and styles of p-k hot water storage heater equipment. A reference work needed by every architect, engineer, contractor or user of hot water for process or service. Because of its size, cost, and importance, will you please request your Free copy on your company letterhead.

the **Patterson-Kelley Co.,** inc.

2130 Burson Street, East Stroudsburg, Penn.

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101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities.

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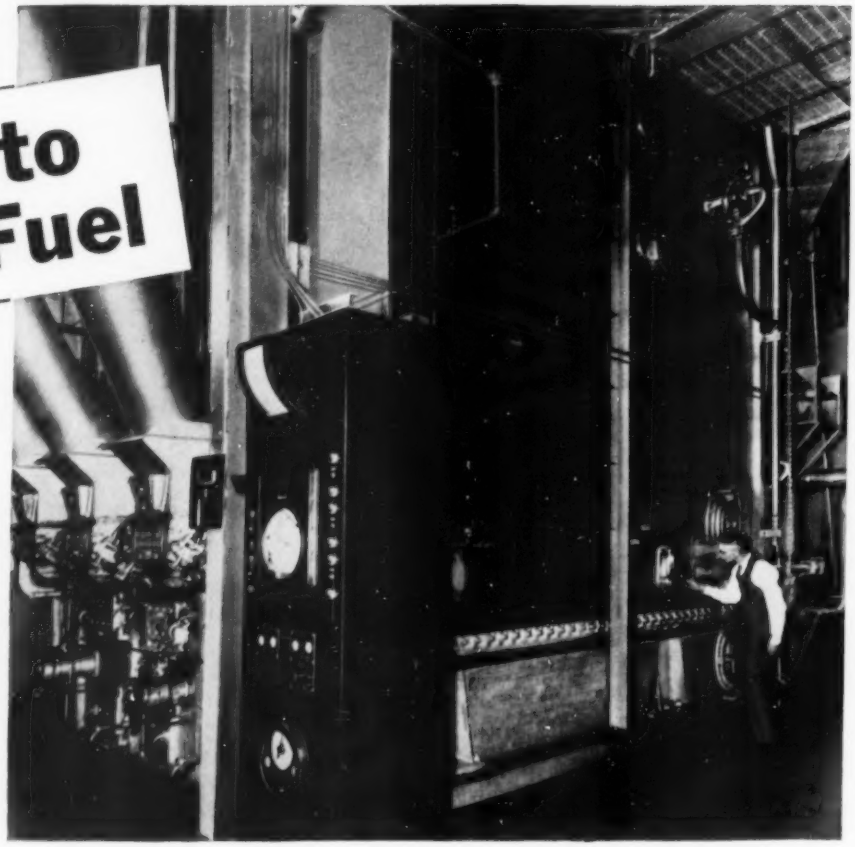
How to Save Fuel



Fuel savings of 15% have resulted from steam plant modernization at General Mills, Inc., Buffalo, N. Y. The program included this installation of Bailey Meter Control on a 45,000 lb per hr, 170 psi spreader stoker-fired boiler.

● The heat energy you get from a unit of fuel depends on the performance of your steam plant equipment. And that's where Bailey controls can help. With a Bailey-engineered control system you can count on a higher output of available energy per unit of fuel. Here's why:

1. Suitable Equipment

When you receive equipment recommendations from a Bailey Engineer his selections come from a complete line of well-engineered and carefully tested products.

2. Seasoned Engineering Experience

Your local Bailey Engineer brings you seasoned engineering experience based on thousands of successful installations involving problems in measurement, combustion, and automatic control.

3. Direct Sales-Service—close to you

For your convenience and to save time and travel expense there's a Bailey District Office or Resident Engineer in or close to your industrial community.

For greater fuel savings, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're glad to stand on our record.

A-121-1

FORMULA
for Cutting
Production Costs
•
+ Bailey Design
+ Bailey Engineering
+ Bailey Service
= Greater Savings
per Fuel Dollar

BAILEY
METER COMPANY
1040 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

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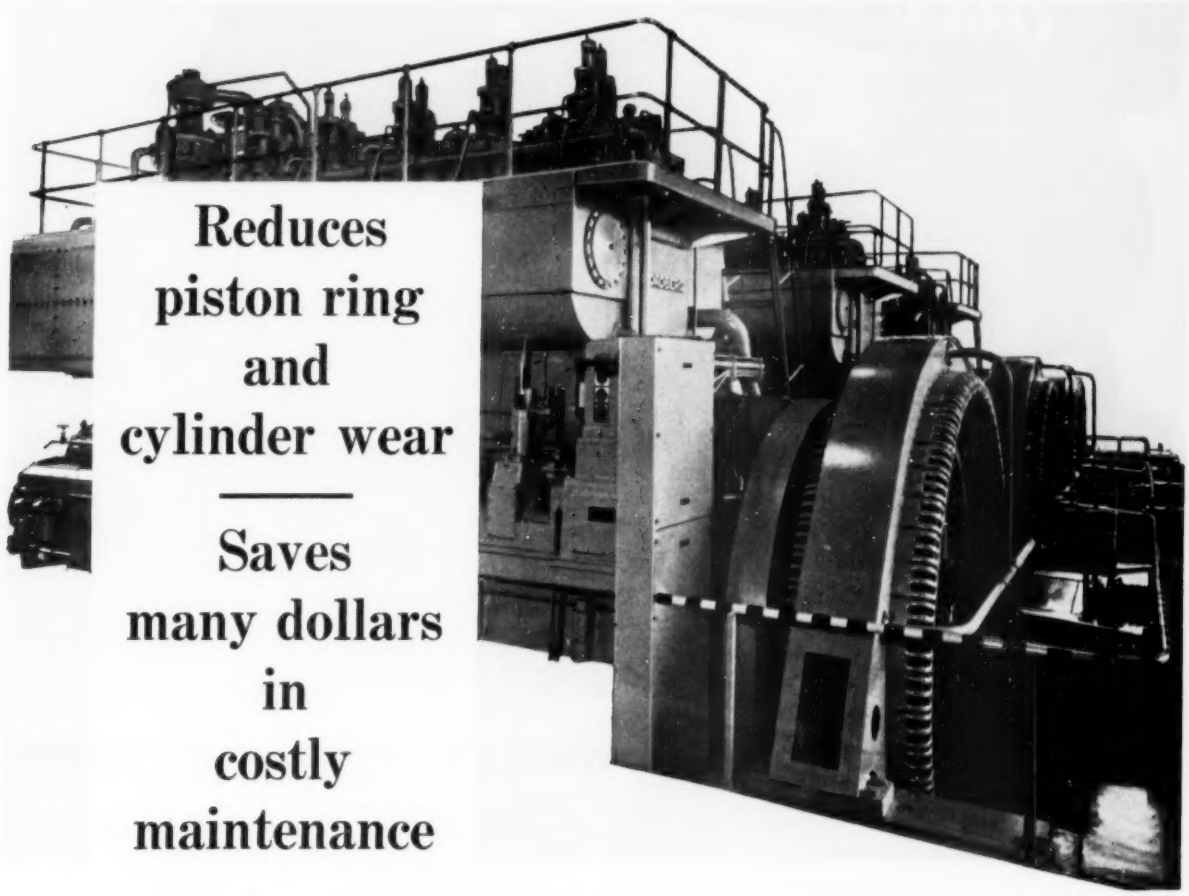
Shell Rotella Oil



Reduces piston ring and cylinder wear

Saves many dollars in costly maintenance

These dual-fuel engines in the Municipal Power Plant at Houma, Louisiana, supply dependable, low-cost electric power to the entire city. Shell Rotella Oil is the cylinder lubricant.

Here's just one of the many diesel power plants that depend on SHELL ROTELLA OIL for reduced wear of engine parts . . . lower maintenance cost.

The anti-corrosive action in Shell Rotella Oil combats the major cause of engine wear . . . cylinder and piston ring wear caused by acid action from the by-products of incomplete combustion and condensation.

Tougher lubricating film in Shell Rotella Oil gives cylinders and rings greater protection . . . minimizes wear. Its effective detergent-dispersant action prevents harmful deposits.

Write for technical information. See for yourself how Shell Rotella Oil can help reduce your engine maintenance costs.

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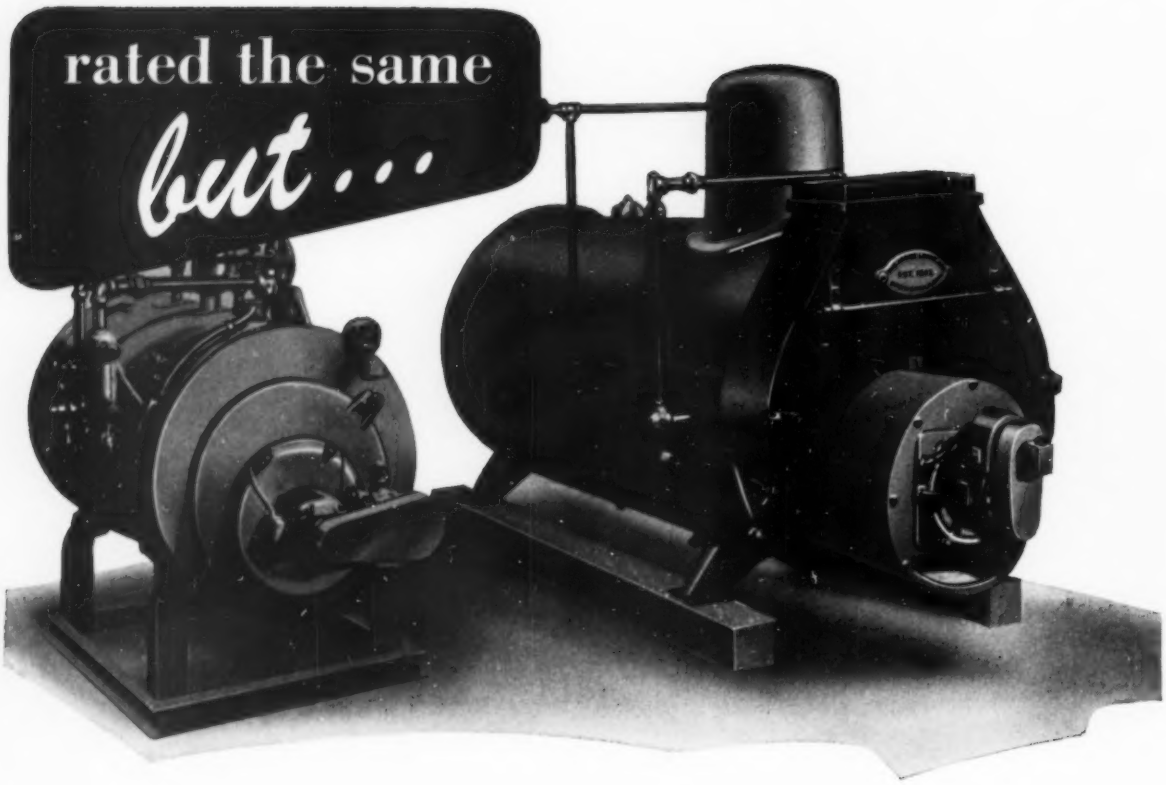


only the bigger, stronger LEFFEL can deliver when you need extra steam

Look at these figures

	LEFFEL BOILER	A "PACKAGE-TYPE" BOILER
Rating	20 HP	20 HP
Length	9'	6' ±
Height	6'8"	4'6" ±
Heating Surface	181 sq. ft.	54 sq. ft. ±
Shipping Weight	6500 lbs.	2500 lbs. ±
ACTUAL MAXIMUM CAPACITY	40 HP 1380# per hr.	20 HP 690# per hr. ±

It will pay you — in the long run — to compare carefully and buy wisely.

The Leffel boiler is rated at 20 H.P.; so is the little "package-type" steam boiler. All similarity ends with that claimed rating.

The package boiler may deliver 20 H.P. — but no more. The Leffel boiler can be operated day after day at *50 percent above its rating;* in an emergency it can deliver up to 40 H.P. with safety.

Claims can't help you get steam from a boiler which is prone to break down under the strain of continuous operation — which just can't deliver beyond its rating.

There's no corner-cutting in the construction of a Leffel boiler. It's built to take it. Performance proves that Leffel's extra-rugged construction means greater dependability and longer life, plus the ability to carry a 100% overload in an emergency.

One look should tell you that the bigger, obviously stronger Leffel boiler will be a more reliable source for the steam you need. And you will find that despite their greater strength and greater capacity, Leffel boilers are competitively priced.

If you're looking for a completely dependable source for low-cost steam, trouble-free service and simple operation, you'll want to know more about Leffel boilers. They are built in a complete range of sizes from the smallest to the largest Scotch types, for oil, gas or coal firing. Bulletin 236 has all the details; send for your copy today.

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPT. A, SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT STEAM GENERATION FOR 92 YEARS

For more data circle 535 on Post Card

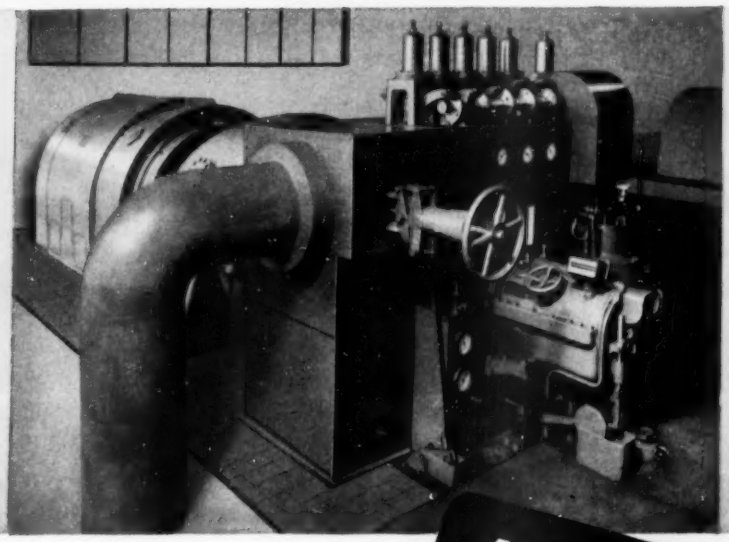
How a Southern Paper Company

Cuts Power Costs Three Ways

1
Eliminates Tube Failure

2
Reduces Maintenance

3
Cuts Blowdown Requirements



Main turbine room contains five turbine-generator units. You can get complete information on silica removal by writing for a copy of Bulletin 28R7135.

In a 33-month period, a southern paper company replaced 133 tubes and welded others. Now, after installation of Allis-Chalmers water conditioning, tube failures have been completely eliminated — along with virtual elimination of unscheduled maintenance. In addition, boilers have operated at top rating and efficiency for 12 months between scheduled cleanings. Blowdown requirements have become approximately half what they were before.

ALLIS-CHALMERS
WATER CONDITIONING
Equipment — Chemicals — Service

Remove Silica Content in Boiler Water

The job was done by reducing silica content 94% through use of a water conditioning system designed by Allis-Chalmers water conditioning experts. Before installation, silica content averaged 43.6 ppm. Now it averages 2.7 ppm. Equipment includes a 24,000-gph hot process softener, three 10-ft *Anthrafilt* filters, a surge tank, and chemical feeder. The system has been improved since original installation by the addition of a secondary hot phosphate unit.

How You Can Solve Your Water Problems

For any water problem, you'll find Allis-Chalmers chemicals, service, and equipment a useful addition to your power or process water application. Years of experience combined with a complete line of equipment enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4200

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

For more data circle 536 on Post Card

ONLY UNDER DIRECT FLAME, will GE's new self-extinguishing insulation for metal-clad switchgear char—as demonstrated in this picture with flame of blow-torch applied directly to the new laminated sheet-type insulation.

General Electric "Self-X" insulation gives

New sheet-type material with exclusive, flame-retardant feature localizes damage that may occur under abnormal conditions

The equivalent of a "built-in fire extinguisher"—a flame-retardant insulation for switchgear, marks the most recent General Electric development for even safer, more dependable metal-clad switchgear—industry's standard for 2400- to 13,800-volt circuits.

In introducing this flame-retardant insulation—which was perfected by Nicholas F. Arone, engineer in its Switchgear Department in Philadelphia—G.E. has gone far to minimize all potential fire hazards in switchgear.

All good insulating material has three standard properties: high mechanical strength, high dielectric strength, and a non-hygroscopic quality. To this group, G.E. is the first to add an important fourth property: a self-extinguishing characteristic that *refuses to sustain combustion.*

The laminated insulation sheet will burn and char—but *only* if an outside source of flame remains in contact with the sheet itself. Once the source is removed, polyvinylchlorides "smother" the flame in less than a minute—localize damage—and permit quick access to compartments for inspection and maintenance.

In bus and cable supports, in insulating barriers between compartments, in box barriers for arc chutes—throughout vital spots of metal-clad, GE's new flame-retardant insulation works for greater protection under *all* conditions—without extra cost to you.

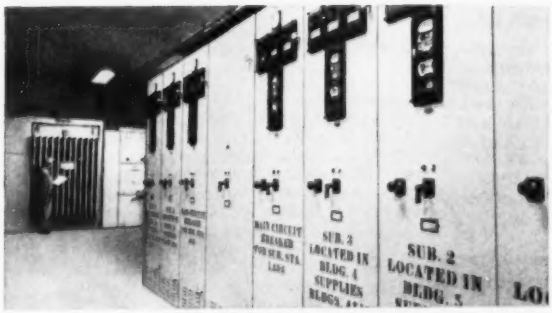
For information on improved Metal-Clad Switchgear, with new, flame-retardant insulation, call your nearest G-E sales representative, or write to General Electric Company, Schenectady 5, N. Y. 87-3

G. E. BURENS, *general manager, Switchgear and Control Division, presents Coffin Award to N. F. Arone for development of outstanding new insulation. Coffin Award is General Electric's highest employee honor.*

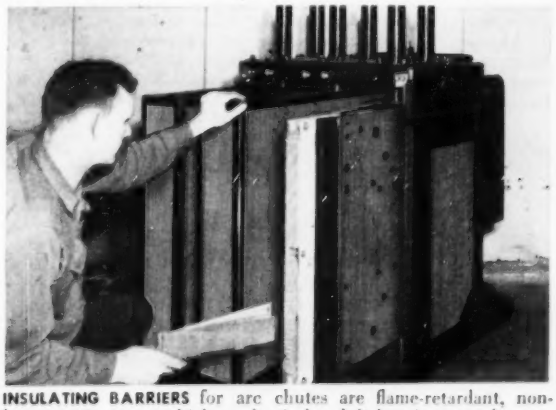
GENERAL ELECTRIC

WITH FLAME REMOVED, the flame-retardant insulation refuses to sustain combustion—and extinguishes itself in less than 60 seconds. Polyvinyl-chlorides in the laminated sheet "smother" the flame, permitting ready access to compartments for inspection and maintenance.

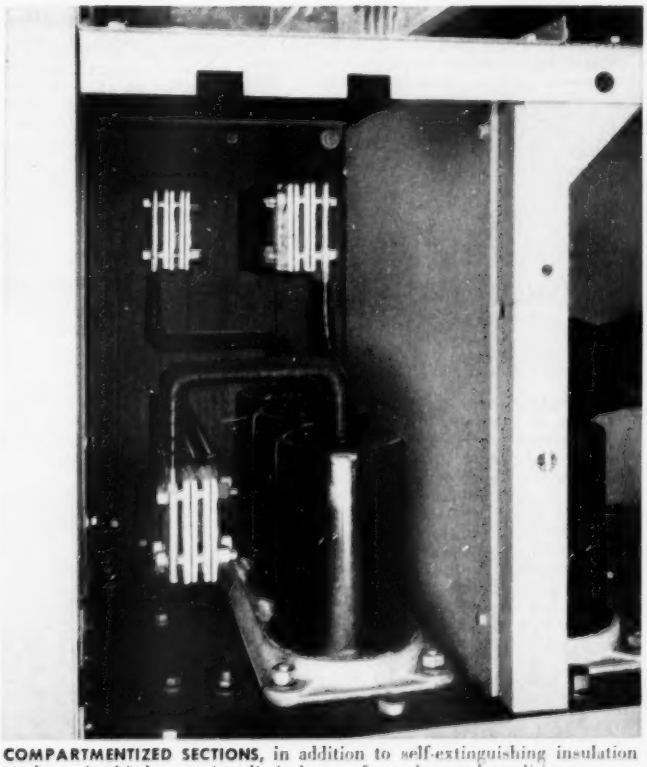
added protection to metal-clad switchgear



THIS METAL-CLAD SWITCHGEAR lineup features GE's new flame-retardant insulation at vital points throughout all sections.



INSULATING BARRIERS for arc chutes are flame-retardant, non-hygroscopic, possess high mechanical and dielectric strength.



COMPARTMENTIZED SECTIONS, in addition to self-extinguishing insulation as shown in this bus section, limit damage from abnormal conditions.

For more data circle 537 on Post Card

EQUIPMENT NEWS

1—RELAY for high speed protection of transmission lines

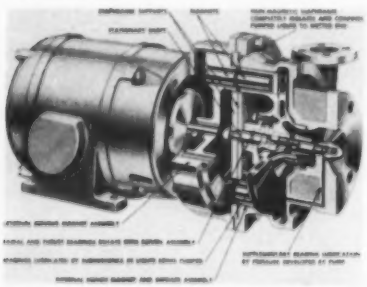
An improved model of this company's HZM Modified Zone Distance Impedance Relay is designed to protect transmission lines from phase faults occurring on single lines, closed loops and parallel lines. It also serves to give backup protection for adjoining line sections. The relay is rated at 1–10 ohm range, 115 v, 60 cycles operating winding and 125 and 250 v d-c trip circuits.

The auxiliary adjusting unit is self-contained within the Flexitest relay case in the new model. This unit is used to modify the impedance characteristics of the relay, thus providing phase-angle discrimination between load and fault conditions. Its inclusion within the case facilitates testing of the relay, it is pointed out, and eliminates the need for mounting an additional external auxiliary unit. Westinghouse Electric Corp.

2—MAGNETIC DRIVE PUMP confines liquids to wetted end

This pump is announced as one in which liquids are isolated and confined to the wetted end and which has no rotating connection between driven pump end and liquid pump end. An end-suction, horizontal centrifugal type unit, this magnetic-drive horizontal pump has no rotating seals, packing or rotating member between driver and driven unit.

Sealing of the liquid end of the pump is by means of a magnetic drive. Power is transmitted from motor to pump by matching magnetic fields, from adjacent opposite poles, mounted around the



periphery of the driving and driven elements. A circular disk, with 12 to 24 permanent magnets (depending on pump size) is attached to the rotating shaft; this drives a similar size permanent disk magnet and impeller unit, which is attached to and rotates around a stationary shaft in the liquid end of the pump. There is no connection between driving and driven magnets, it is explained, and thus a non-magnetic diaphragm separates the driven or liquid end of the pump from the driving end. Because of this separation, and because no rotating connection is maintained between the ends, liquid being pumped in liquid end is confined there, company states.

At the present time, the pump can be powered by 1, 1½ and 2 hp motors operating at 1760 rpm. Applications for the magnetic drive pump are expected to center around processes where a closed system of liquid flow is necessitated, where contamination of pumped liquid cannot be tolerated, or where leakage of the liquid is not permissible. It is suggested for use on liquid lines handling hazardous, toxic or odoriferous pumpable liquids and for pumping extremely hot, or cold, or corrosive liquids. Construction details and other data are available. Peerless Pump Div., Food Machinery and Chemical Corp.

3—PINCH TYPE VALVE designed for handling slurries

The Type K is a manually-operated, quick opening pinch type rubber valve for handling slurries, such as fly ash, with grain sizes up to ⅛ in. and corrosives. It is announced as available in sizes ¼ to 12 in. in pure gum rubber, neoprene, Buna, Butyl, and odorless and tasteless neoprene. Temperature limit is 180 F; pressure limit, 100 psig.

The valve which has snap action at closing point is used for on-off service. Bubble tight closure and self-supporting feature make for positive shut-off and ease of installation, manufacturer states, and only the rubber is in contact with fluid. Mechanical parts are aluminum with nylon bearings. Robert K. Little.

4—PIPE WRENCHES designed for the hard, tough jobs

A new line of heavy duty pipe wrenches for hard, rugged work is announced. It features an easy-action nut and single spring for quicker setting of the jaws, improved handle design for increased strength and better hand grip, and a handy pipe scale on the hookjaw. The new wrenches are available in a full range of sizes from 6 to 48 in. Toledo Pipe Threading Machine Co.

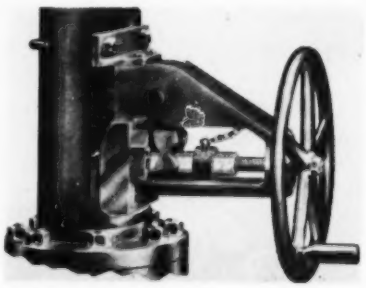
5—PULSATION DAMPENER for use on gage, governor lines

The Micro-Bean has been redesigned to a shorter length and equipped with a filter of stainless steel to prevent corrosion. The body is all brass for 3000-lb operating pressure; or steel with stainless steel microvalve for 6000 lb; or all stainless steel for 10,000 lb. The Micro-Bean's valve has a 96-to-1 taper to eliminate stem and screw compression

strain. When installed ahead of a gage or governor, jitters of the gage pointer are minimized, pulsation is dampened and the line flow is smoothed, manufacturer says. The device has both female threads, ¼ or ½ in. Descriptive literature is offered. J. A. Campbell Co.

6—SIDE HANDWHEEL for emergency manual valve control

Especially designed for use with all of this manufacturer's diaphragm control valves, the new Type Y Continuously Connected Side Handwheel is offered to enable a plant to operate on an emergency basis. The basic handwheel assembly has a high tensile iron frame fitted with oil impregnated bearings. The handwheel screw is made of 18-8



stainless steel with a high tensile aluminum bronze nut for transmitting the power through a cast steel fork to the valve stem.

It is pointed out that when equipped with this handwheel, the control valves can be manually positioned in either direction independently of the normal controlling impulses. The handwheel mechanism provides stops so that travel can be set to cover any portion of the complete valve stroke. Black, Sivalls & Bryson, Inc.

7—PYROMETER CONTROLLERS, millivolt-type actuation

Measuring circuits of this company's Pyr-O-Vane and Protect-O-Vane Controllers have been modified to permit calibration of the instrument for a number of functions including measuring and controlling speed of rotation, power consumption, pressure, or relative acidity or alkalinity. Described as accurate to within 1 per cent, the indicating controllers can be used with sensing elements with output of the proper order of magnitude — tachometers, thermal converters, pH indicators and pressure transducers. Previously the instruments were designed for use with thermocouples and radiamatic units.

The instruments are expected to be particularly suited for use where the extreme sensitivity and versatility of potentiometer type instruments aren't required. Company points out that in such applications the millivoltmeter will be satisfactory and more economical. Industrial Div., Minneapolis-Honeywell Regulator Co.

8—DEMINERALIZER keeps tank filled with high-purity water

This demineralizer has controls designed to permit automatic maintenance of storage tank water supplies at a definite known purity standard. After the regeneration cycle is in its final rinse stage, the operator switches on the controls,

SAFE CONTROL

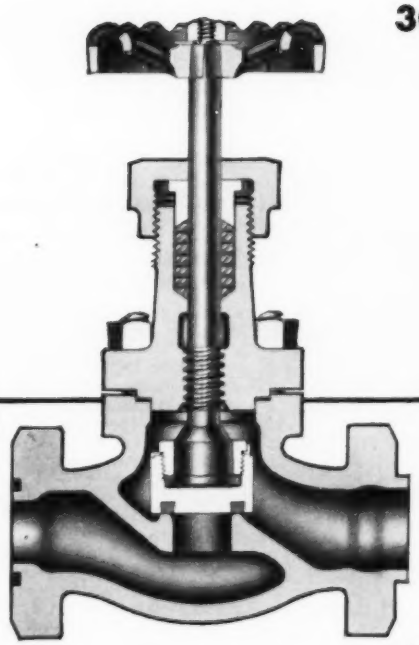
for ammonia and other hard-to-handle fluids

CRANE

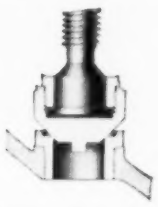
300-pound heavy-duty all-iron valves

Put these Crane valves to the test—use them for ammonia, air, oil, gas, caustic solutions, chlorinated compounds, alcohols—for chemicals and process work. Their rugged bodies of Ferrosteel (35% stronger than cast iron) . . . their precision seating designs . . . the unusually deep stuffing box and high-grade packing . . . the sweeping interior body contours . . . assure the safety and lasting service you want.

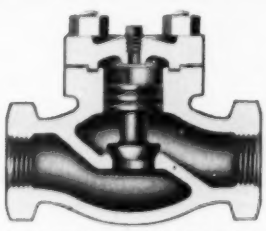
The line includes *bolted bonnet* globes and angles with choice of disc, *union bonnet* globes and angles with plug-type disc, lift checks, expansion valves, relief valves, liquid gauges—and all the fittings, flanges, return bends and other specialties for a complete Crane Quality installation. Check with your Crane man.



Cross-section bolted bonnet Globe, with flanged ends and special lead-faced disc. Sizes ¼ to 4-inch.



Bolted bonnet Globes also available with steel disc and seat where high temperatures or corrosion prohibit use of lead.



Cross-section, Lift Check with bolted cap, and cushioned disc action which increases valve life. Sizes ½ to 2-inch.

New 6-page folder AD1977 catalogs this complete Crane line. Write direct, or ask your Crane Representative.

THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 538 on Post Card

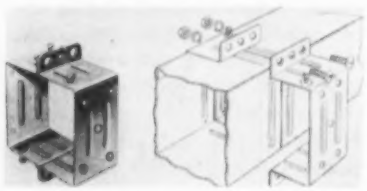
which act automatically and signal when another regeneration cycle is needed. Once the controls take over, the effluent continues to run to drain until a desired preset conductivity is reached; then the high purity water being produced starts to flow to the storage tank, continuing until it is filled.

When the tank level falls to a predetermined point, the demineralizer starts another delivery cycle. Should the purity drop when the tank is being filled, the unit runs to drain, company explains, and if proper conductivity doesn't come back within 27 minutes, the unit stops and signals. All operations except regeneration can be done without an attendant, it is pointed out. Regeneration is accomplished by the "ion-exchange-in-reverse" process of "washing" the cation resins with an acid solution and the anion resins with a caustic solution. Penfield Mfg. Co.

9—SQUEEZE-TYPE COUPLING for joining raceway sections

This two-piece coupling for joining lengths of company's Wirewa was developed especially for use where several sections are pre-assembled. According to manufacturer it provides complete rigidity — so the sections may be lifted into place as a unit. It permits flush wall mounting of the raceway through five $\frac{1}{4}$-in. dia holes pre-drilled in each side.

The 4-by-4 in. electrical raceway sections of 1-, 2- and 3-ft lengths have



hinged covers for accessibility — with a $1\frac{1}{4}$-in. solid ridged enclosure at each end. The new 16-gage pressed steel coupling, $2\frac{1}{2}$-in. wide, is also ridged to key into the individual wireway sections and assure perfect alignment. The coupling has identical forms in order to close over the square wireway end sections. Four cadmium-plated round head bolts with lock washers and hex nuts are provided for a quick grip, and two self-imbedding screws are installed with each coupling to maintain continuity of ground. A third hole in each coupling side may be engaged as a hanger support for the raceway. National Electric Products Corp.

You may use the post cards provided on page 127 to ask for further information on any of these new products

11—DISPOSABLE WIPER, of non-woven, flame-resistant cotton

Now in production, this disposable cotton towel is specially treated for fire resistance, manufacturer announces, and it also offers high absorbency and economy. The towel is designed to absorb more than six times its weight in grease, oil or water, and may be used for wiping, polishing, and cleaning. The size is 12 by 18 in., but may be cut to individual specifications. Available in a wide range of colors, the wipers cost $1\frac{1}{2}$ cents each in pastels and dark shades, $2\frac{1}{4}$ cents each in white. The Leshner Corp.

12—HYDRAULIC OPERATOR for use with circuit breakers

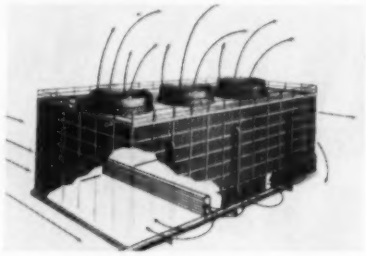
Increased performance demand on power circuit breakers is said to be met through the use of a simplified hydraulic operating mechanism coupled with a mechanical trip-free linkage. The new mechanism stems from two developments made during World War II — the bladder type accumulator for energy storage, and constant viscosity oil for all-weather operation.

The 5-gal capacity accumulator, with peak capability of 400 hp, is described as one of the most efficient means of energy storage known. Consisting of a steel bottle, it stores energy in the form of compressed nitrogen within an integral Buna N synthetic rubber compound separator bladder having integral high pressure valve assembly. The bladder is charged with dry nitrogen and recharging can be done in the field, company says, but this shouldn't be necessary for many years.

Operational tests are reported to show that when a hydraulic mechanism is used to close a circuit breaker, the closing time can be less than with a pneumatic mechanism — yet the movable contact member in the tank will have a lower maximum velocity. Accordingly, the impact during high speed closing is less, it is noted, with reduced strain on contacts, bushings. Allis Chalmers Mfg. Co.

13—COOLING TOWER designed to reduce recirculation

An engineering feature which reduces cooling tower recirculation by using equalizing channels between each cell of the tower to balance pressure and reduce recirculation is announced. To prevent exhausted air from being forced downward into the inlet area and recirculated through the tower, manufacturer has introduced equalizing channels into large,



multi-cell towers which relieve the pressure differential existing between the windward and leeward sides.

Pressure is thereby equalized on both sides of the tower, it is explained, and during the presence of strong horizontal winds, the channels allow air to pass completely through the tower in order to equalize pressure. The degree of recirculation determines the tower's performance, it is pointed out, and this varies with the type of cooling tower installation. Company engineers claim location or obstructions in the vicinity of the tower will not impede its performance, and that the equalizing channels will balance pressure and reduce recirculation under all atmospheric conditions. Santa Fe Tank & Tower Co.

14—LARGE FILTERS are compact, multiple surface units

These large capacity filters have filter areas up to 720 sq ft and cake space capacity to 35 cu ft. The filter medium is high-temperature-resistant porous stainless steel and the container can be either carbon steel or stainless steel for corrosive service. The compact design is said to permit steam jacketing, high pressure construction, sanitary construction and ease of cleaning.

According to manufacturer, the medium utilized prevents "break-through" point, or pressure above which clarity of filtrate is no longer obtained, and it is a perfect support medium for filter-aid because it will not pass the filter-aid during the filtration cycle. These filters are suggested for clarification service and solids collection with such diverse fluids as water, petroleum products, molten metals. Micro Metallic Corp.

10—TRANSFORMER, substation size, utilizes new cooling method

Reductions in height and weight and a new cooling method are features of this new substation size transformer. The cooling method utilizes chimney-type radiators, instead of numerous tubes — company engineers say this construction allows a lower height design and a reduction in weight without any sacrifice in electrical characteristics. Weight of the transformer has been cut more than 6 per cent, and the height $2\frac{1}{2}$ ft.

The unit has large smooth surfaces instead of numerous smaller round surfaces, making it easier to paint, it is noted, and a reduction in the number of openings into the transformer tank adds to its strength and tightness. The new transformer is now available in ratings of 250 kva, high voltage 15,000 v and below. General Electric Company.

15—SWITCHBOARD for low voltage distribution applications

Several design advantages characterize this new line of switchboards for low voltage distribution use. An isolated wiring trough provides ample space for laying conductors and there are drop-off openings per section for neater and safer wiring. Higher short circuit capacity of main bus bars is attributed to edgewise mounting in a clamping arrangement. Although featuring more compact construction, the new design has reserve space for future circuits and offers flexibility of circuit arrangement.

The new switchboards provide standardized sections for branch circuit break-

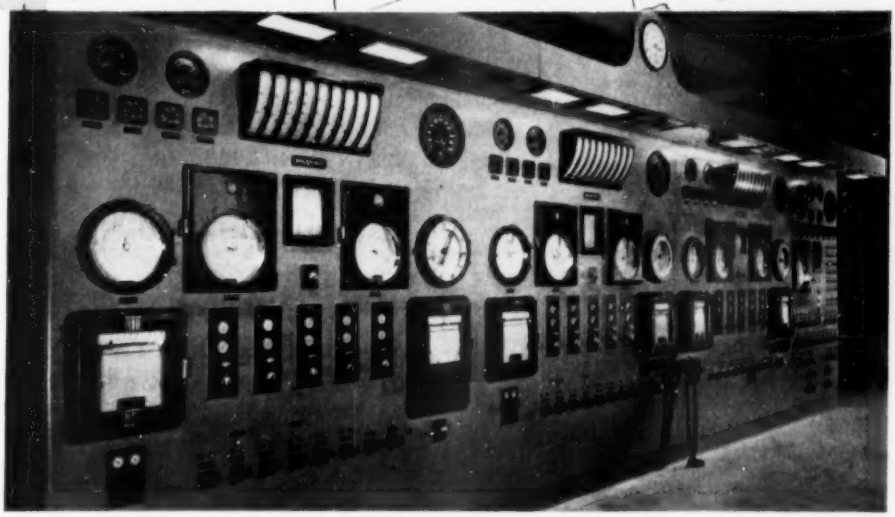
IN THE PHILIPPINES

MANILA ELECTRIC REBUILDS . . .

installs REPUBLIC *Automatic*

COMBUSTION CONTROLS

to get maximum combustion efficiency



All three boilers are checked and controlled from this master control panel which contains Republic gauges, recorders, continuous integrators, manual-automatic transfer sub-panels and biasing sub-panels for adjusting oil-air ratio.

From war-wrecked power facilities in 1945 to modern equipment with a generating capacity of over 140,000 kw today is the rehabilitation achievement of which Manila Electric Company can be proud. Typical of the modern equipment now operating is this new 50,000 kw power station. Designed by Gilbert Associates, Inc., it contains three oil-fired boilers, each rated at 250,000 lbs. per hr. at 875 psig and 910° F. To maintain the operation of these boilers at maximum efficiency under all load conditions, Republic Automatic Combustion Controls have been installed. Pressure reducing valves and controls plus feedwater pump controls were also furnished by Republic.

This is but one example of power stations all over the world that are equipped with Republic Combustion Controls. Recent over-seas installations include stations in Italy, Greece, Chile, India and Australia.

Wherever the station, whatever the fuel, draft arrangements or load characteristic, Republic Combustion Controls can operate boilers to hold fuel and air in the correct amounts and proportion for maximum combustion efficiency.

Get the details in Data Book S-21 or contact your nearby Republic field engineer.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY · CHICAGO 47, ILLINOIS

For more data circle 539 on Post Card

ers or switches and for main incoming line equipment, the group of sections necessary to handle the various components being bolted together to form a rigid assembly. Square D Co.

16—CONTROLLED VOLUME PUMP operates in pumped liquid

The Mersemetric, a controlled volume pump without diaphragm or open seal, is completely submerged in the liquid being pumped. Manufacturer says there is no external leakage, and in handling concentrated sulfuric acid, for example, the Mersemetric can be immersed in the storage tank. The unit, a flow control instrument, is available in a wide range of materials of construction. Capacities range from 3 ml per hour to 400 gph, and pressures up to 1000 psi. Bulletin 1153-B describes pump. Milton Roy Co.

17—SHIELDED CABLES have tough outer jacket of Teflon

These flexible miniature shielded cables have a tough outer jacket of Teflon to protect against mechanical damage while electrically insulating the metallic shield from surrounding objects. The cables are supplied in many standard constructions, including single and multi-

conductor types with conductor sizes from No. 20 to 30 AWG. Both outer jacket and conductor dielectrics are Teflon to permit continuous operation at temperatures from −90 to 250 F, with maximum operating voltages to 1000 v RMS. The metallic shield is made of close woven, flexible silver plated copper braid. The outer jackets on the cables come in a choice of ten colors that speed tracing in complex circuitry. Literature and samples are offered. Tensolite Insulated Wire Co., Inc.

18—INDICATING LIGHTS, oil-tight, for heavy duty use

These oil-tight indicating lights are offered for manufacturer's line of oil tight pushbuttons, selector switches and accessory controls. Their all-glass faceted lenses, available in six colors, are factory sealed to metal caps and feature all-angle visibility. They are designed for both front and back mounting which, company claims, provides more versatility and easier installation. They come in three forms — resistor, transformer, and full-voltage — and are rated from 110 to 600 v with a 10-amp continuous rating. General Electric Co.

19—SMALL GAGE for draft and differential metering

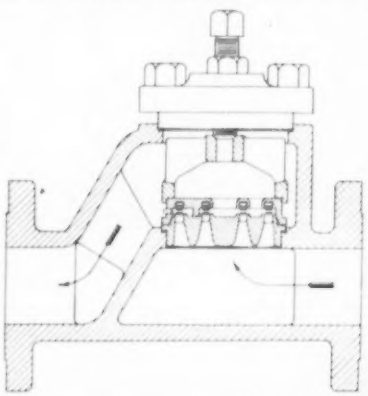
Complete in one case, this bantam gage is said to need no extra transmitters or accessory mechanisms for its operation. It is designed to measure draft, pressure, vacuum, or differential draft. With a bezel only $6\frac{7}{16}$ in. high, this new gage is declared ideal for use on compact console and graphic panels. As many as eight gages may be mounted in a case.

The 5-in. graduation length of the V-5 scale compares favorably with the scale length of larger sized gages, according to manufacturer, and illumination from the rear increases visibility and readability

at distances. The gage can be connected into standard lighting circuits. Full-sized diaphragms or bellows are used for no reduction in accuracy or sensitivity. Diaphragm elements are available for pressure ranges as low as 0.6 in. and as high as 40 in. of water. Equipped with bellows elements, the gage may be used as a receiver for pneumatic transmission pressure between 5 and 30 psi. It can also be furnished with two bellows and two pointers for steam flow-air flow or fuel-air indication. Specification Folio 805 gives full details on this gage. Republic Flow Meters Co.

20—AUTOMATIC VALVES for higher than usual pressures

Airchek Automatic Valves are designed to suit conditions of service as high as 500 psig. Installed in the discharge line of air and gas compressors, this valve



acts to check noise, vibration and tank ring. It is said to be particularly suited as a check valve for air lines. More information is available in Bulletin 509-C. Pennsylvania Pump & Compressor Co.

21—VOLT-AMMETER is hook-on recording type unit

This portable recording instrument, the Type CF-7, has been developed for obtaining a permanent record of alternating current and voltages. It is said to combine the features of a self-latching multi-range hook-on current transformer with the simplicity of company's inkless recorder (Type CF) in equipment suitable for indoor and outdoor applications. It is expected to be particularly useful for checking loads on distribution lines, verifying motor loads, and in detecting overload circuits.

The equipment consists of a hook-on current transformer, a connecting lead, and an inkless recording volt-ammeter, all interchangeable. According to manufacturer, alternating current can be measured and recorded on both insulated and non-insulated conductors in circuits operating at potentials up to 8700 v — by hooking the current transformer around the lines and connecting the recorder to a 120/240-v a-c source. Featuring a self-supporting hook suitable for conductors up to 2 in. dia, the transformer provides current ranges from 15 to 750 amp.

Company engineers point out that no auxiliary equipment is needed to measure wide-range a-c voltages since the recorder itself measures voltages in three ranges (0 to 150/300/750 v) by means of the range-changing switch. Amperage ranges are 15/75/150/750; frequency 50 or 60 cycles. General Electric Co.

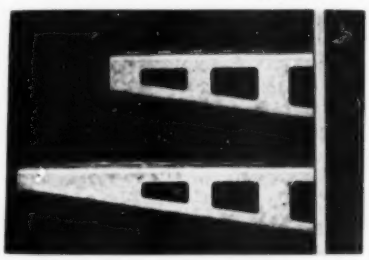
22—FLOW METER offers safety, accuracy and versatility

Designed for safety and convenience in rate-of-flow measurement, the new SK Safeguard Rotameter has an enclosed steel meter case with detachable safety glass windows to protect the tube from external shock and act as a safeguard in the event of accidental tube breakage. The rigid construction of this meter affords precise end fitting alignment, company points out, eliminating pipe stresses on the tube. Versatility is achieved by standardized construction which permits use of up to four sizes of meter tubes in one meter case. Also, the variety of rotor designs available affords a wide range of capacities within one meter size.

Wide front and rear windows are provided for maximum visibility and the detachable metal reference scale is plainly marked. Scales are calibrated either in units of flow or in millimeters. The SK Safeguard Rotameter is adaptable for electric, or pneumatic transmission and remote recording of flow. Bulletin 18-RG gives data. Schutte and Koerting Co.

23—QUICK-MOUNTING BRACKET for pipe support system

Manufacturers of Rakit, a simplified supporting system for cable trough, cable, pipe, and conduit, announce the development of a one-piece bracket which reduces considerably the assembly time required. The new supports can



be placed securely into slotted vertical channel pieces by a twist of the wrist, it is explained, no fasteners being necessary. The bracket is available in 3-, 7-, 13-, and 19-in. lengths, and greater lengths can be obtained by means of bracket extenders. The Rakit Corp.

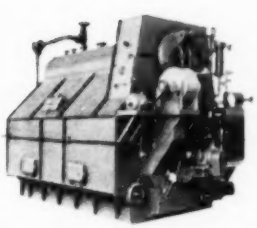
100th ANNIVERSARY WICKES BOILERS 1854-1954

Early photograph of Wickes' shop force

The year was 1854. Franklin Pierce was President. Stephen A. Douglas was leading a fight to abolish the Missouri Compromise on slavery. The railroads were beginning their first westward expansion . . . just the year before, rail connection had been established between New York and Chicago. Only 10 years before, Samuel F. B. Morse had invented the telegraph, and new inventions were rapidly changing the face of American industry. Large scale production was at hand, and industry stood on the threshold of a new, remarkable era.

Though the first Wickes Boilers would look crude indeed alongside the highly efficient units Wickes makes today, they were quite advanced for their time, and industry soon learned that the name Wickes stood for dependable low-cost steam production. Through constant research, expansion of manufacturing facilities and the introduction of modern production techniques, Wickes has maintained that position of leadership for the last 100 years.

Today, Wickes can supply your requirements for steam generators capable of producing 500,000 lbs. steam per hour at pressures up to 1000 psi. — all types of multiple drum boilers adaptable to any standard method of firing. For pressures up to 900 psi., with sustained steam production up to 40,000 lbs., Wickes Type A Boilers can be shop-assembled, ready for immediate installation. Consult your nearest Wickes representative or write today for descriptive literature.



WICKES THE WICKES BOILER COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

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RECOGNIZED QUALITY SINCE 1854

152

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CONSTRUCTION NEWS

Arkadelphia, Ark. — Arkansas Power & Light Co., Pine Bluff, Ark., has preliminary plans under way for new steam-electric generating plant near Arkadelphia, where site has been selected. Details and estimates of cost will be determined soon. Station will represent an investment of several million dollars.

Los Angeles, Calif. — Firestone Tire & Rubber Co., 2525 Firestone Blvd., Florence District, has approved plans for addition to steam-generating plant at local factory, with installation of additional equipment for increased capacity. No official estimate of cost announced. Work will proceed at once. Justin A. Shjarback, 1312 South Garfield Ave., Alhambra, Calif., is engineer.

Richvale, Calif. — Richvale Irrigation District, Richvale, has made application to State Division of Water Resources for permission to proceed with a water and power development in Butte County, including construction of series of five hydroelectric power plants, with initial installed capacity of 258,000-hp. Entire project will represent an estimated investment of $90,000,000. Frank E. Bonner, 1 Montgomery St., San Francisco, Calif., is electrical engineer for power development. Glen R. Harris is director of District.

San Francisco, Calif. — Pacific Gas & Electric Co., 245 Market St., is arranging a construction budget for 1954 to cost about $170,000,000, including steam-electric and hydroelectric power plants, switching stations, power substations, transmission lines and other facilities. Company has work under way on steam-electric installation in power plant at Pittsburg, Calif., with rated capacity of 600,000-kw. Construction also in progress on new hydroelectric generating station, with capacity of 84,000-kw. Plans are under way for new hydroelectric power plants on Feather River and Kings River.

Miami, Fla. — Florida Power & Light Co., 25 South 2nd St., has arranged for sale of a block of preferred stock totaling $6,250,000, fund to be used for expansion and improvements in generating plants, power substations, transmission lines and other operating facilities.

Atlanta, Ga. — H. W. Lay & Co., Inc., 173 Blvd., N. E., potato chips and other food specialties, is considering construction of a boiler house at proposed new plant near city limits, where large tract of land has been selected. It will consist of a main one-story building for processing and general production, and several smaller structures for auxiliary service. Entire program reported to cost over $1,000,000. It is proposed to carry out work this spring.

Augusta, Ga. — Pet Milk Co., Arcade Bldg., St. Louis, Mo., plans boiler house at proposed new milk-processing and ice cream plant near Augusta, where tract of land has been selected. It will comprise several one-story buildings and is estimated to cost close to $1,500,000. Work is scheduled to begin soon.

Hammond, Ind. — Northern Indiana Public Service Co., Hammond, is arranging an expansion and improvement program during next 24 mos., to cost about $49,000,000, including increased generating capacity, power substations, transmission and distributing lines, and other work. Financing in part will be arranged at once.

Scott City, Kan. — Wheatland Electric Co-operative, Inc., Scott City, plans extensions in Jess Taylor steam-electric generating station near city, with installation of new turbine-generator unit and accessories, high-pressure boiler and auxiliary equipment. Cost estimated over $2,000,000. Frank Horton & Co., Lamar, Mo. is consulting engineer.

Louisville, Ky. — Louisville Gas & Electric Co., 311 West Chestnut St., is arranging a construction budget for next 24 mos. to cost approximately $35,500,000. Work will include extensions and improvements in generating plants and system for increased capacity. As recently noted in these columns, company has approved expansion in generating plant on Ohio River, with installation of additional equipment, estimated to cost about $12,500,000, and this will form part of program.

Fitchburg, Mass. — Fitchburg Gas & Electric Light Co., 655 Main St., has disposed of a note issue of $1,500,000, considerable portion of proceeds to be used for extensions and improvements in generating station and system.

Jackson, Mich. — Consumers Power Co., Jackson, has arranged a construction budget of about $63,000,000 for expansion and improvements in electric and gas properties during 1954, of which approximately $50,000,000 will be used for electric division, including expansion in power plants at Bay City and Muskegon, on which work has been started, to increase gross capacity by 270,000-kw at each plant. Other work will include power substations, transmission lines and miscellaneous construction.

Marquette, Mich. — Upper Peninsular Generating Co., 16 Sheldon Ave., Houghton, Mich., J. H. Warden, president, recently organized, has secured permission from Michigan Public Service Commission to proceed with construction of proposed new steam-electric generating station at Marquette, lately noted in these columns. Installation will include a 22,000-kw turbine generator, high-pressure boilers and auxiliary equipment. Cost estimated about $7,500,000, including transmission line to Ishpeming, Mich., for service at plant of Cleveland Cliffs Iron Co., at that place.

St. Clair, Mich. — Michigan Iron & Coke Co., Book Bldg., Detroit, Mich., plans power plant at proposed new iron and coke works, near St. Clair, where tract of about 600 acres has been selected, fronting on St. Clair River. Project will include a large group of buildings and is estimated to cost close to $35,000,000. Proposed to begin work in near future. Arthur G. McKee & Co., 2300 Chester St., Cleveland, Ohio, is engineer.

Kansas City, Mo. — Kansas City Power & Light Co. is arranging a fund of about $21,500,000 for expansion and improvements in properties in 1954, including increased generating capacity, power substations, transmission lines and other operating facilities.

Omaha, Neb. — Omaha Public Power District, 17th and Harney Sts., is arranging financing through sale of bond issue in amount of $12,000,000, fund to be used over period of about 36 mos. for expansion in generating capacity, transmission lines and miscellaneous construction. J. M. Harding is president.

Point Pleasant, N. J. — Jersey Central Power & Light Co., 501 Grand Ave., Asbury Park, N. J., will have plans prepared by Burns & Roe, Inc., 233 Broadway, New York, N. Y., consulting engineer, for proposed new steam-electric generating plant in vicinity of Point Pleasant, recently noted in these columns. Project is reported to cost over $30,000,000, including reinforced-concrete power house, turbine-generators, high-pressure boilers and auxiliary equipment. Work is expected to begin in 1954.

Akron, Ohio — Ohio Edison Co., Akron, has arranged a construction budget for 1954 to cost approximately $19,000,000, including extensions and improvements in generating stations, power substations, transmission and distributing lines.

Tulsa, Okla. — Public Service Co. of Oklahoma, 600 South Main St., has authorized a construction budget of $22,600,000 in 1954, for extensions and improvements in power plants, for increased output, power substations, transmission lines and other operating facilities.

Philadelphia, Pa. — Kraft Foods Co., Division of National Dairy Products Corp., 500 North Peshtigo Ct., Chicago, Ill., cheese and other food specialties, plans boiler house at proposed new branch processing and production plant at Roosevelt Blvd. and Welsh Rd., Philadelphia. Main unit will be one-story, about 80,000 sq ft floor space. Entire project reported to cost about $1,000,000. Proposed to begin work this spring.

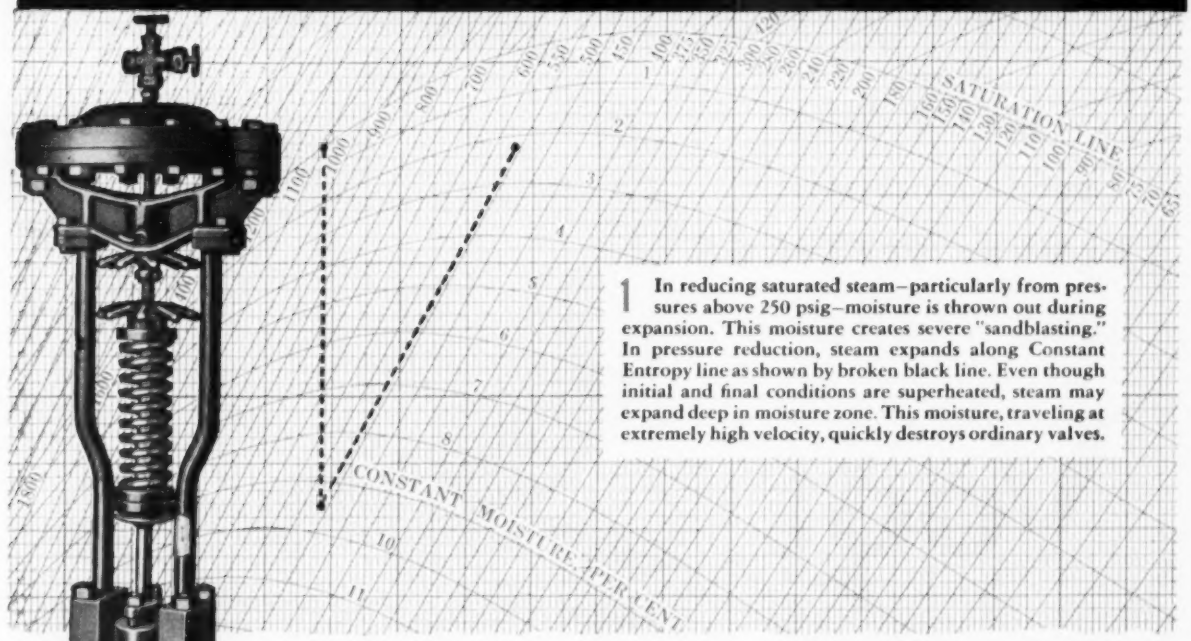
Amherst, Tex. — Southwestern Public Service Co., Amarillo, Tex., has approved plans for new addition to steam-electric generating plant at Amherst, with installation of new turbine-generator unit, high-pressure boiler and auxiliary equipment. Work to be carried out at once. Cost reported about $12,000,000.

Seminole, Tex. — City Service Oil Co., Bartlesville, Okla., plans steam power house at proposed new natural gasoline plant, in vicinity of Seminole, where property has been secured in oil field area of Gaines County. Project will include a group of one- and multi-story structures to process casing head gas, and will represent reported investment of several million dollars.

Roanoke, Va. — Appalachian Electric Power Co., Roanoke, has disposed of a bond issue totaling about $20,000,000, larger part of fund to be used in connection with 1954 expansion and improvement program, including generating stations, power substations, transmission lines and other operating facilities.

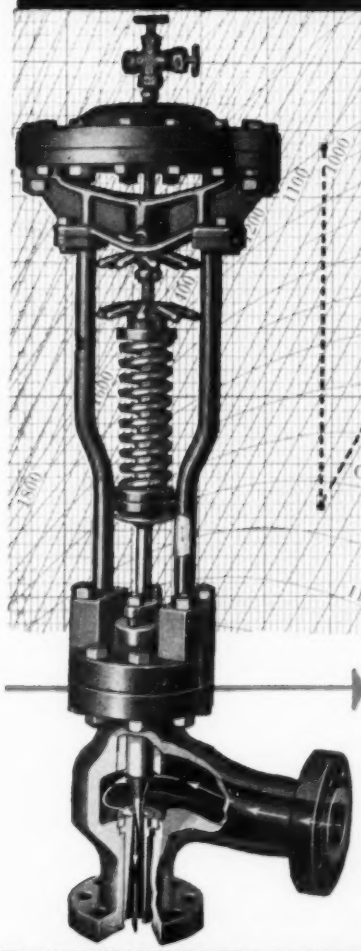
Wenatchee, Wash. — Puget Sound Power & Light Co., Stuart Bldg., Seattle, Wash., is projecting plans for new hydroelectric power development on Columbia River, about 50 mi. from Wenatchee. Work will include power dam and generating station, with initial capacity of about 400,000-kw, to be advanced later to 600,000-kw. Project is estimated to cost about $190,000,000, including transmission lines, switching stations and other operating facilities.

Swartwout V-10 Flow Regulating Valves slash maintenance costs in systems with high pressure drop or flashing condensate



1 In reducing saturated steam—particularly from pressures above 250 psig—moisture is thrown out during expansion. This moisture creates severe "sandblasting." In pressure reduction, steam expands along Constant Entropy line as shown by broken black line. Even though initial and final conditions are superheated, steam may expand deep in moisture zone. This moisture, traveling at extremely high velocity, quickly destroys ordinary valves.

Chart from Thermodynamic Properties of Steam by Keenan & Keyes. Reproduced by permission of John Wiley & Sons, Inc., Publishers



2 Swartwout V-10 valves are scientifically designed to handle liquids at high pressure drops and also under *flashing conditions.* All direct impingement is eliminated and longer valve life is assured two ways—by better flow design, plus use of materials specifically selected for the service involved. As a result, *Swartwout V-10 valves outperform other valves in similar service.*

Swartwout

POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
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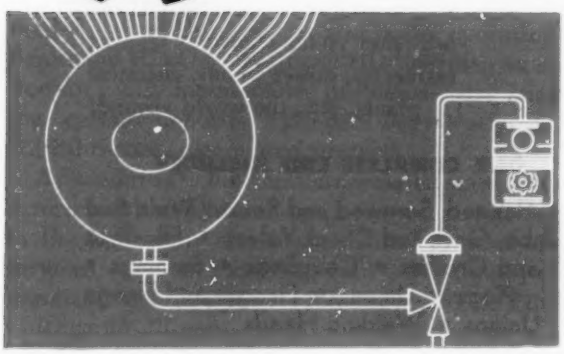
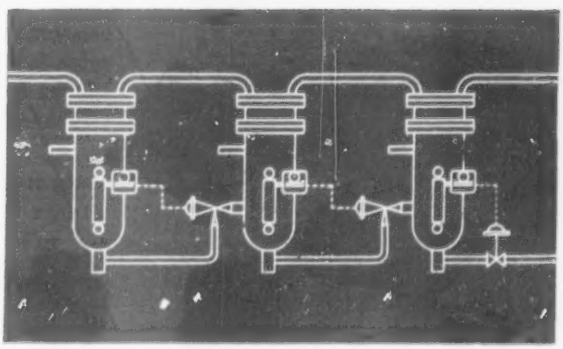


3 High pressure boiler blowdown service is extremely rigorous. When closed, there is full pressure drop across valve; when open, high velocities and flashing rapidly increase line loss and decrease the allowable drop across the valve. The variations in pressure make this service critical since valve must handle all conditions.



4 In saturated liquid drainage service, such as on high pressure extraction type heaters, water at saturation temperature flashes into steam when pressure is reduced. Exclusive scroll inlet and gradually expanded straight outlet of V-10 valve design permit a sliding action instead of direct impingement thus preventing corrosion-erosion. A 1298

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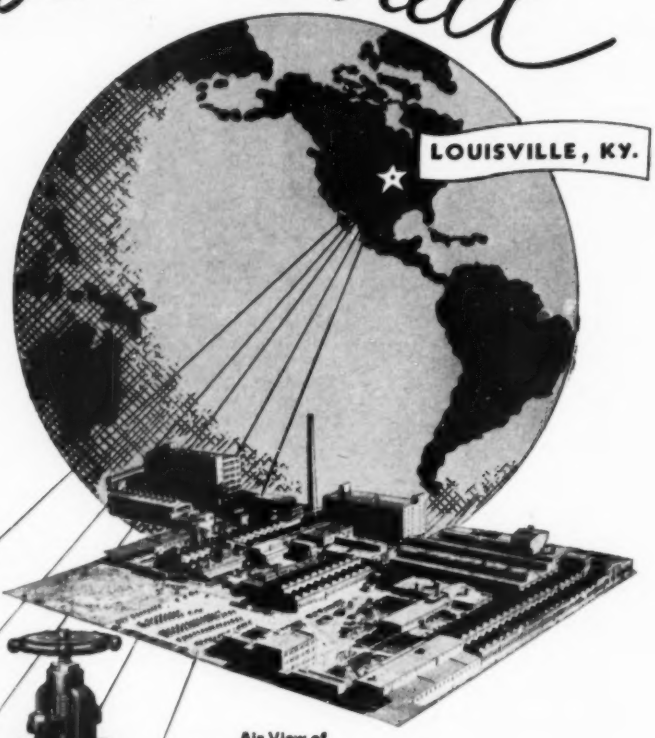

Air View of
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New diesels get same "lube diet" that kept old units healthy...

For many years, the Las Animas Municipal Power and Light Company kept its original diesel equipment operating at remarkably low cost. Using Standard diesel oils, down time and maintenance were negligible in spite of greatly increased loads that forced the units far beyond their rated capacities.

In 1951, when two new 1750 hp. Nordbergs were installed in the Las Animas, Colorado, power plant, it was natural for plant officials to select STANDARD HD Diesel Oil on the basis of this outstanding past performance.

Used exclusively in the new units, STANDARD HD has set a new high for healthy performance. In over two years of continuous hard service, STANDARD HD has supplied clean, protective lubrication. After 6000 hours of operation wear was so slight that it could not be measured; engines are kept clean constantly in all working parts.

STANDARD HD
TRADE MARK
OIL

Ralph Barbee, plant superintendent of the Las Animas Municipal Power and Light Company, checks the operating log with E. C. Jeffries, Standard Oil lubrication specialist.

• Diesel plant operators throughout the Midwest have discovered they can count on low cost diesel operation when they use STANDARD HD Oil. STANDARD HD provides an economical solution for costly maintenance problems—ring sticking and breaking, carbon deposits, cylinder wear—because STANDARD HD Oil lubricates, cleans *and* protects.

A Standard Oil lubrication specialist stationed near your plant throughout the Midwest can help you secure successful results in the operation and maintenance of your diesels. For his services, call your local Standard Oil Company office. Or write: Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.

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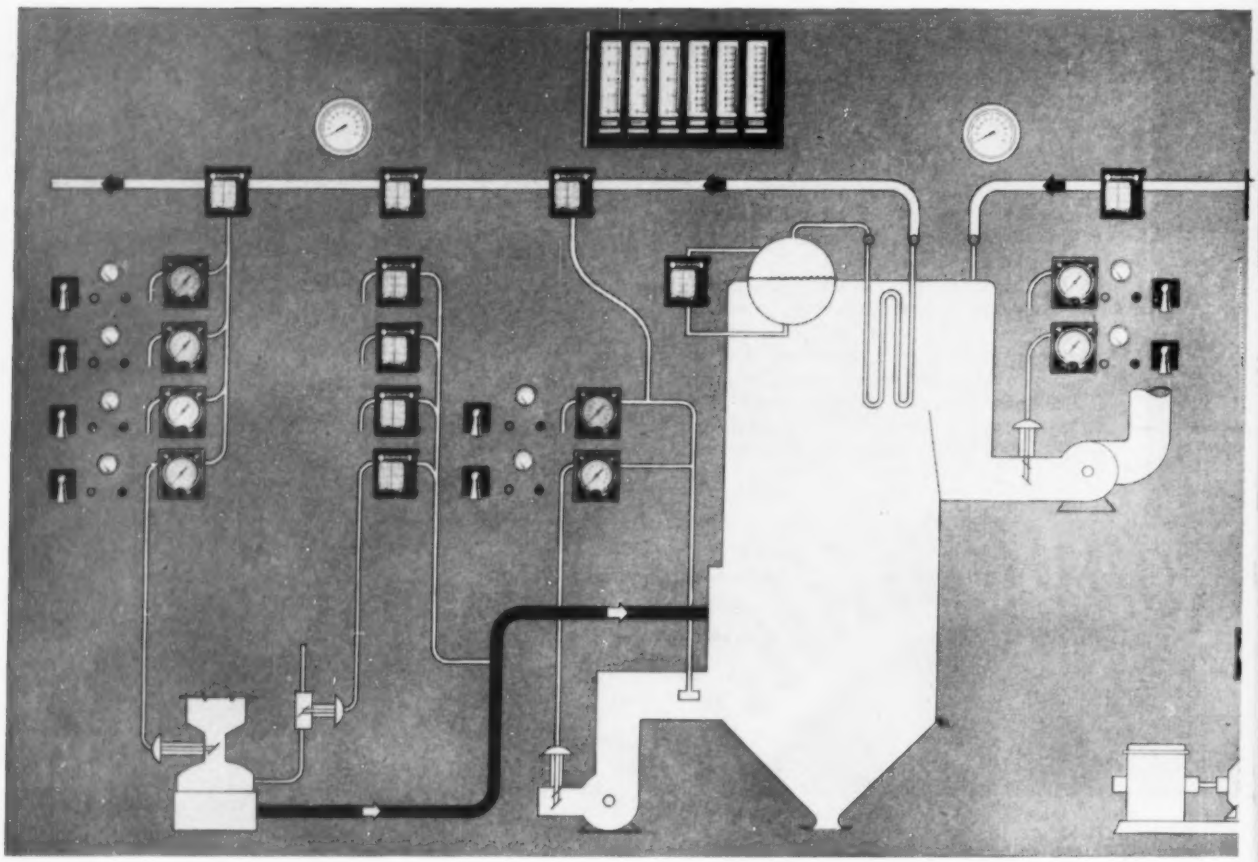
TO REDUCE



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Combustion may be controlled from steam flow-air flow, or by fuel-air-ratio method. Instrumentation of the most modern design by Taylor assures fast response, accurate control and utmost dependability.

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Boiler Feed Water may be controlled from three, two or one influences. Feed water control systems may have *instrumentation by Taylor* (Type 3-L, Bulletin 1013), or be electrically or mechanically operated.

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Pressure reducing valves to meet any need. Steam temperature control may be from three or two influences, using burner or damper positioning, gas recirculation, direct water spray or heat exchanger.

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Full automatic-sequential control may be part of main panel or set up on separate panel. Individual push button control available. For smaller boilers there are manually operated units in several types.

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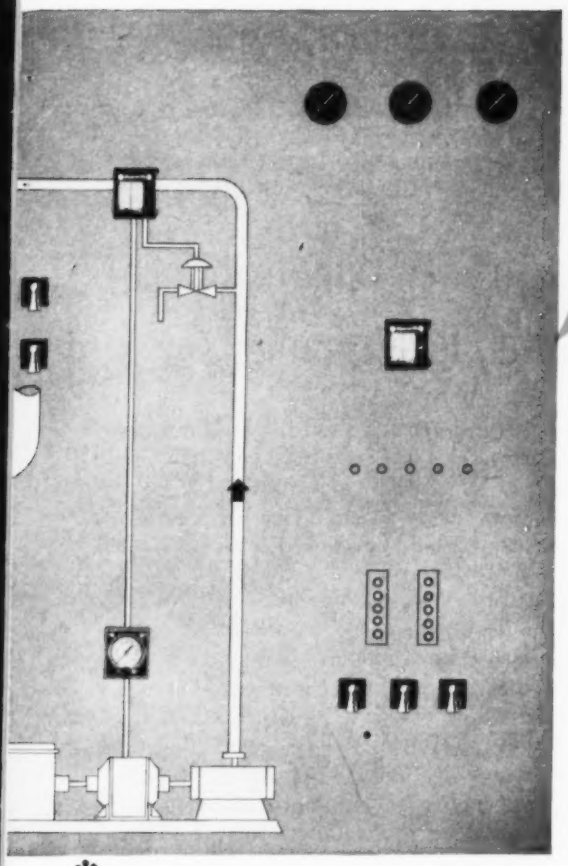

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WHEN you plan to modernize your power facilities, check into the many advantages offered by Copes-Vulcan Boiler Control.

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A new "wide vision" face on Yarway Remote Liquid Level Indicators allows reading from the side as well as front of the indicator. Boiler water levels and other liquid levels can be checked from most any position.

Indicating mechanism is operated by the boiler water level itself—assuring instant, accurate readings.

Yarway Indicators are of the manometric type with automatic temperature compensation, as approved for use under the recent A.S.M.E. Boiler Code Committee ruling in Case # 1155.

Over 10,000 are used throughout industry for boiler water and other liquid level indication . . . and for superheater pressure differential indication aboard ship.

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Besides Remote Liquid Level Indicators, Yarway also offers Liquid Level Recorders and Remote Signal Alarms . . . making a complete system for constant, accurate liquid level check.

■ Yarway Hi-Lo-Graph Recorder provides not only water level indication, but also a 24-hour recording of water levels. See Yarway Bulletin WG-1830.

■ Yarway Remote Hi-Lo-Alarm Signals—lights or horns—can be placed at any location in plant. See Yarway Bulletin WG-1823.

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Unit No. 2 on Line at St. Clair; Units 3 & 4 Coming Up

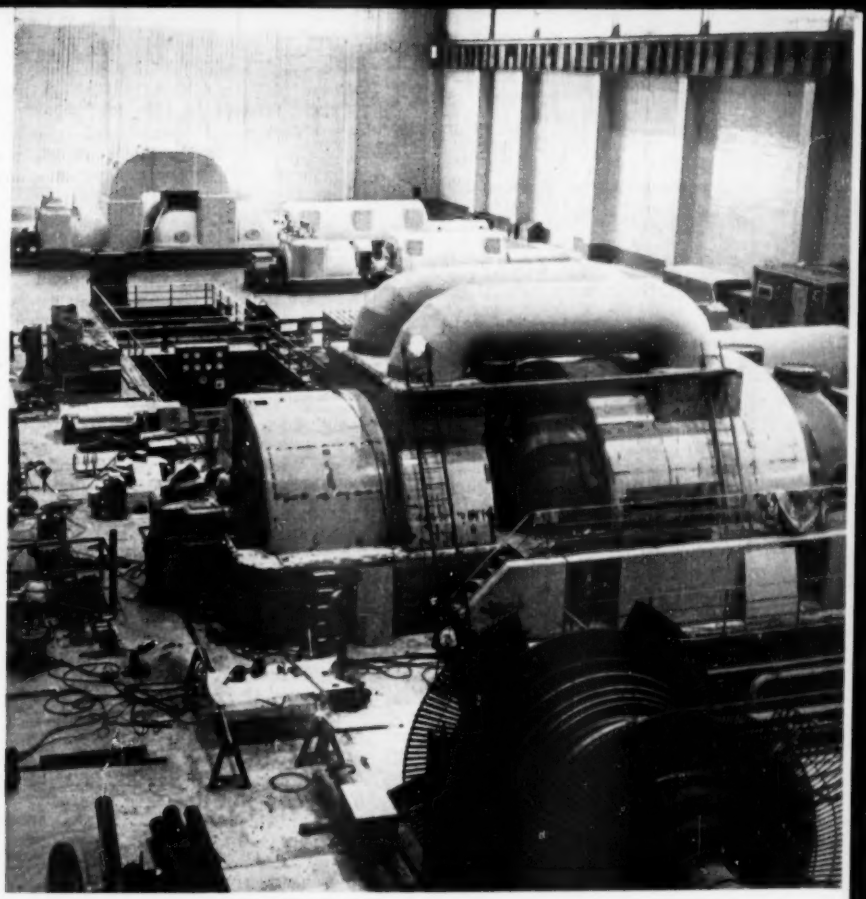


Fig. 1. (Above) St. Clair's turbine room a few days before No. 2 Unit's start-up. In far distance is Unit No. 1. End of No. 2 is visible in foreground

Fig. 2. (Below) Unusual view of stacks and part of breeching at Detroit Edison's St. Clair station

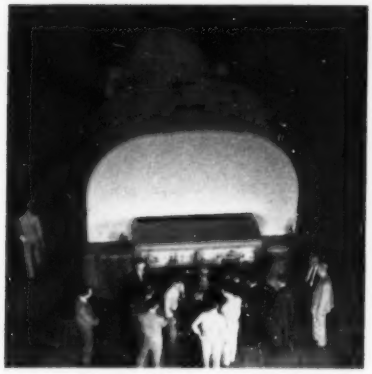


Fig. 3. Visitors examining high-pressure end of No. 2 Unit when it went into operation in November

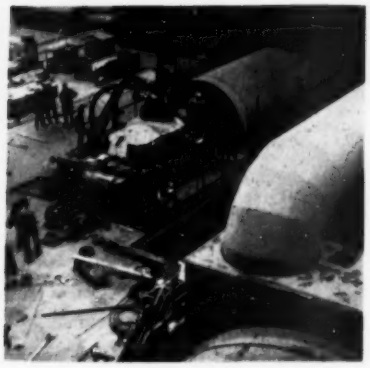


Fig. 4. Unit No. 2 under construction. In the background the high-pressure turbine is being assembled

ELECTRIC POWER supply throughout Michigan's Thumb area was increased by 150,000 kw on Nov. 29, 1953 with the starting up of another steam turbine generator at Detroit Edison's St. Clair Power Plant.

The plant, still under construction, will be formally dedicated next year. It is located on the St. Clair riverfront midway between the communities of St. Clair and Marine City.

James F. Fogarty, a member of Edison's board of directors, started the new turbine and brought it up to operating speed. Among those present at the ceremony were civic and press representatives of the Thumb area, and Edison officials including President Walker L. Cisler and George F. Campau, Superintendent of the St. Clair plant.

The new generator is the second of four to be placed in operation at St. Clair, bringing the station up to one-half its planned capacity. The two final units are slated to be producing power by next July, when the total generating capability of Edison's five-plant system will be more than 3,300,000 horsepower.

In addition to the activity at St. Clair, Edison has already started work on a new station at River Rouge. There, foundation piling is being driven for a plant that will eventually house the two largest steam turbine generators in the world. Each turbine-generator will be capable of producing 260,000 kws. The 125-acre Rouge site, already bustling with men, will be a very busy scene of activity when the peak construction period is reached when there will be 1,500 to 1,800 men at work. The new plant's superstructure will be of steel panel design. Two stacks will rise 425 ft above ground level.

Edison power plants now operating, besides the St. Clair, are at Trenton, Delray and Conners Creek, in the metropolitan Detroit area; and Marysville, near Port Huron. Total generating capability is now 2,195,000 kw, or nearly 3,000,000 horsepower. Edison supplies electricity to 3,700,000 people — more than half the population of the state — in a 7,600-square-mile area that includes most of Southeastern Michigan.

The company's power output has doubled during the past 10 years.

St. Clair Power Plant was designed in its entirety by Detroit Edison personnel. Major contractor on the actual construction was United Engineers & Constructors of Philadelphia. By the time the four units are in at St. Clair and two units on Detroit Edison's line at River Rouge, our total generating capability will be more than 3,000,000 kw.

144 WAYS to Parallel Transformers. . . . Which is Right One for You ??

Do transformer terminal markings confuse you? These charts will save you time and worry. They show right connections for all possible combinations of wye-delta and delta-wye transformers. Keep them for future reference

By ROBERT S. HORN*

MUCH EXCELLENT material has been published about transformers and their connections, but the particular group of connections for the parallel operation of wye-delta 3-phase transformers is seldom fully covered. This is evidenced by the untold numbers of 3-phase transformers which have been needlessly reconnected internally.

These charts have been prepared to help those concerned with this subject in the field. They were prepared to show, in the very simplest manner, the exact changes that must be made in order to bring about the desired result. It is significant that the changes necessary for parallel operation of any wye-delta or delta-wye connected 3-phase transformer with any other wye-delta or delta-wye connected 3-phase transformer, amount to nothing more than relabeling the terminals.

A 3-phase delta-wye (or wye-delta) connected transformer having a given set of X_1 X_2 X_3 and H_1 H_2 H_3 terminal markings may have any one of six different phase displacements of the voltage across X_1 X_2 with respect to the voltage across H_1 H_2. This displacement is 30, 90, 150, 210, 270, or 330 degrees, depending upon the arrangement of the terminal markings or, as is commonly said, depending upon the internal connections. As there are six wye-delta connections and six delta-wye connections, there are, in all, twelve different transformer connections in these two groups. A 3-phase transformer having any one of the twelve connections may be required to operate in parallel or "phase-in" with a second 3-phase transformer which may also have any one of the twelve connections. This gives twelve squared or 144 possible combinations, taking one from each of two sets of twelve.

A single chart having sufficient area to show reconnecting diagrams corresponding to the 144 combinations would in this case be inconveniently large. To overcome this, a set of three small charts has been prepared. In explaining the use of these charts, two transformers are considered for parallel operation and they are called transformers "A" and "B". Either one or both of these transformers could have any one of the twelve connections shown in Chart II. When the terminals on one transformer are to be relabeled so that it will "phase-in" with another, the transformer to be changed must in all cases be considered transformer "B" in Charts II and III.

Chart II contains a set of twelve vector diagrams similar to those found on the name plates on wye-delta and delta-wye connected 3-phase transformers. This chart includes all the diagrams that pertain to these transformers; however, it does not include all the positions in which the diagrams might be drawn. If, for example, when comparing a vector diagram on a transformer nameplate with those on the chart, an exactly similar diagram cannot be located, the chart should be rotated until a diagram is found that is electrically equivalent to the one on the name plate. By doing this it will become evident that the chart contains the electrical equivalent of all diagrams that can possibly be drawn for a wye-delta or delta-wye connected transformer using a counter-clockwise direction of rotation.

If a name plate diagram has a direction of rotation opposite to those on the chart, the name plate diagram should be visualized as though it were viewed through the plate from the rear side so that it will have a direction of rotation corresponding with the chart. This reversal of the diagram introduces no error whatsoever. One way of making a diagram that has a reversed physical direction of rotation to that of a name plate diagram is to make a copy of the name plate diagram on a piece of paper that is backed by carbon paper with the carbon side up. The carbon diagram made on the back of the paper will have the reversed physical direction of rotation desired. The diagram will be physically reversed in other respects also, but as long as the "H" and "X" symbols are not read in reverse this method is reliable.

Chart II is for the specific purpose of classifying numerically the twelve diagrams shown. The classification numbers appear on the chart under the heading, "Class Number and Phase Angle." Chart I contains the 144 combinations previously mentioned. This is a transfer chart to connect Chart II with Chart III.

The charts are used as follows: (1) Determine the class number for transformer "A" and the class number for transformer "B" as given by Chart II, and let us say, for example, that these class numbers are 4 and 9 respectively; (2) Locate in Chart I class number 4 under transformer "A" and class number 9 under transformer "B" and read the diagram number of 6 horizontally opposite class number 4 and vertically below class number 9; (3) Locate on Chart III the diagram number, which in this example is 6, and read the corresponding changes required for the terminal designations on transformer "B."

Most wye-delta and delta-wye connected three-phase transformers have a primary-to-secondary phase displacement of either 30 or 330 degrees; consequently diagrams 1, 6, 7 and 12 in Chart I will be the ones most frequently used.

The charts may also be applied to a wye-delta or delta-wye connected bank of single-phase transformers. In such a case, a bank of transformers may be considered the equivalent of a 3-phase transformer, namely one that has but three primary and three secondary terminals, not including neutrals. The charts also apply to banks of instrument transformers that supply power to power-directional relays where connections known as the 30, 60 and 90 deg connections are used.

The accuracy of these charts has been verified by exhaustive tests made in the shops of an electric utility organization. During the tests a constant phase rotation was maintained for all of the six-phase displacements and the results were checked by several observers.

*Consulting Electrical Engineer, Navy Department, Guam, M. I.

If you want additional copies of these charts for your file, write to us. Don't tear your copy; the next man might like to read it

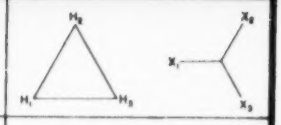
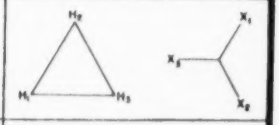
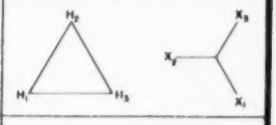
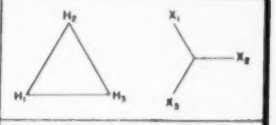
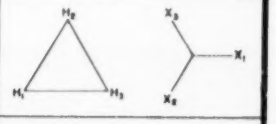
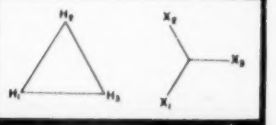
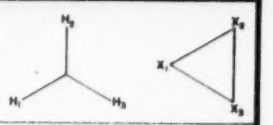
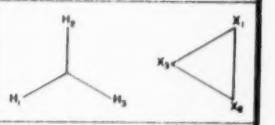
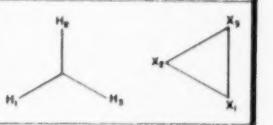
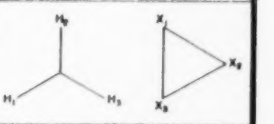
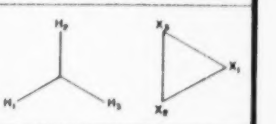
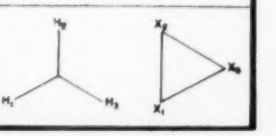
CLASS NUMBER, TRANSFORMER "A"	CLASS NUMBER, TRANSFORMER "B"											
	1	2	3	4	5	6	7	8	9	10	11	12
	DIAGRAM NUMBERS FOR USE ON CHART III											
1	1	2	3	4	5	6	1	2	3	4	5	6
2	3	1	2	5	6	4	3	1	2	5	6	4
3	2	3	1	6	4	5	2	3	1	6	4	5
4	4	5	6	1	2	3	4	5	6	1	2	3
5	5	6	4	3	1	2	5	6	4	3	1	2
6	6	4	5	2	3	1	6	4	5	2	3	1
7	1	2	3	4	5	6	1	2	3	4	5	6
8	3	1	2	5	6	4	3	1	2	5	6	4
9	2	3	1	6	4	5	2	3	1	6	4	5
10	4	5	6	1	2	3	4	5	6	1	2	3
11	5	6	4	3	1	2	5	6	4	3	1	2
12	6	4	5	2	3	1	6	4	5	2	3	1

Chart I. (above) Transfer chart for connecting charts II and III. The transformers to be run in parallel, are classified on chart II, then transfer chart is used to select right transformer connection from chart III

Chart II. → Classification of various 3-phase transformer connections. The twelve vector diagrams are similar to the nameplate diagrams on delta-wye and wye-delta connected transformers. Having determined the class numbers of each of the two transformers to be connected in parallel, the changes required in the terminal markings for correct operation are shown in chart III. In order to reduce the total number of diagrams required in calculation, transfer chart is used to connect chart II with chart III

Chart III. (below) Diagrams for reconnecting 3-phase wye-delta or delta-wye transformers for correct parallel operation. To reduce number of diagrams, transfer chart is used to connect charts II and III

DIAGRAM NO.	* EXISTING TERMINAL DESIGNATION ◆ REQUIRED TERMINAL DESIGNATION
1	* H_1 H_2 H_3 X_1 X_2 X_3 ◆ H_1 H_2 H_3 X_1 X_2 X_3
2	* H_1 H_2 H_3 X_1 X_2 X_3 ◆ H_1 H_2 H_3 X_2 X_3 X_1
3	* H_1 H_2 H_3 X_1 X_2 X_3 ◆ H_1 H_2 H_3 X_3 X_1 X_2
4	* H_1 H_2 H_3 X_1 X_2 X_3 ◆ H_3 H_2 H_1 X_2 X_1 X_3
5	* H_1 H_2 H_3 X_1 X_2 X_3 ◆ H_3 H_2 H_1 X_1 X_3 X_2
6	* H_1 H_2 H_3 X_1 X_2 X_3 ◆ H_3 H_2 H_1 X_3 X_2 X_1

CLASS NO. AND PHASE ANGLE	VECTOR DIAGRAMS FOR USE IN CLASSIFYING TRANSFORMERS "A" AND "B"
	DELTA-WYE GROUP
1 30°	
2 150°	
3 270°	
4 90°	
5 210°	
6 330°	
	WYE-DELTA GROUP
7 30°	
8 150°	
9 270°	
10 90°	
11 210°	
12 330°	

STUD-WELD YOUR INSULATION

Here's a new application for stud welding—fastening insulation to metal surfaces. Special studs are welded to the metal surface, the insulation is impaled on the studs, a clip is placed over the stud, and the result is an easily applied, strong, low-cost job. Technique may be used for any insulation that can be impaled, such as fiberglass, foamglass, felts, magnesia products and cork

These are the studs ▶

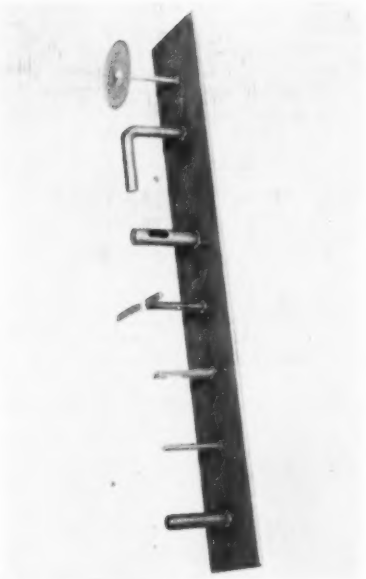


Fig. 1. Stud types. From top: Headed, bent, lagging, split, metal lath stud, headless, threaded

Fig. 2. Fibrous glass is easily secured with a headed insulation stud which is welded through the material

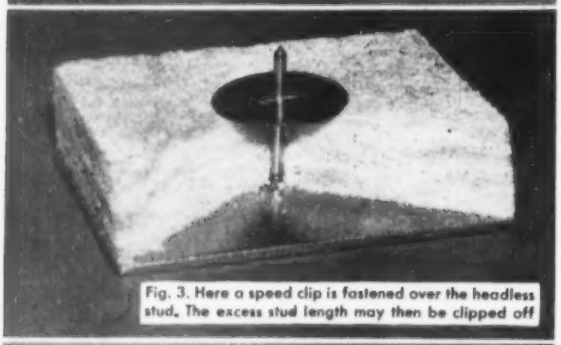


Fig. 3. Here a speed clip is fastened over the headless stud. The excess stud length may then be clipped off

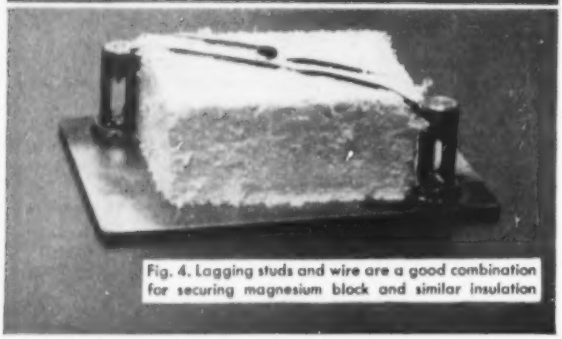


Fig. 4. Lagging studs and wire are a good combination for securing magnesium block and similar insulation

This is how insulation is held

Figs. 2 to 6 show how studs hold insulation in place. For each material there is one stud which does the best job. For some materials the stud can be welded directly through the material onto the steel surface without the use of a ferrule

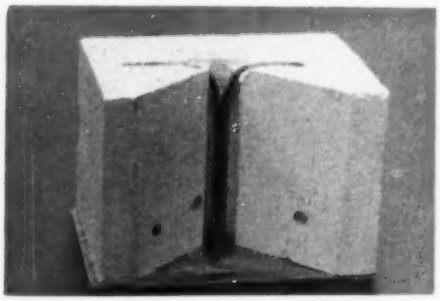


Fig. 5. Split studs do a good job of securing readily-impaled block insulation such as the Kaylo shown in this application

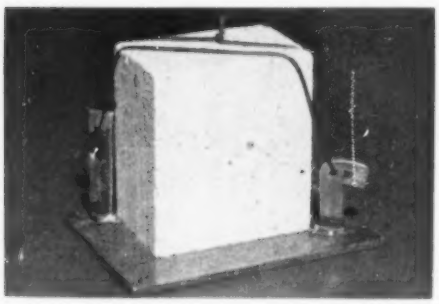


Fig. 6. Another very effective way to secure Kaylo and other block type insulation using metal lath studs and banding wire

Fig. 7. Fixing a quarter of a million 2½ in. long steel pins for holding Foamglas insulation on the surface of the 225 ft diam sphere at the Knolls Atomic Power Laboratory

Fig. 8. General view of the leakproof sphere at Knolls Atomic Power Laboratory shows surface being covered with insulation

This is how it is applied

Studs are applied with a special lightweight welding gun. Figs. 7 to 10 show them being fixed to curved metal surfaces, for which they are particularly effective. Here they are being applied to a giant sphere at Knolls Atomic Power Laboratory

For more imformation write STUD-WELDING on the postcard

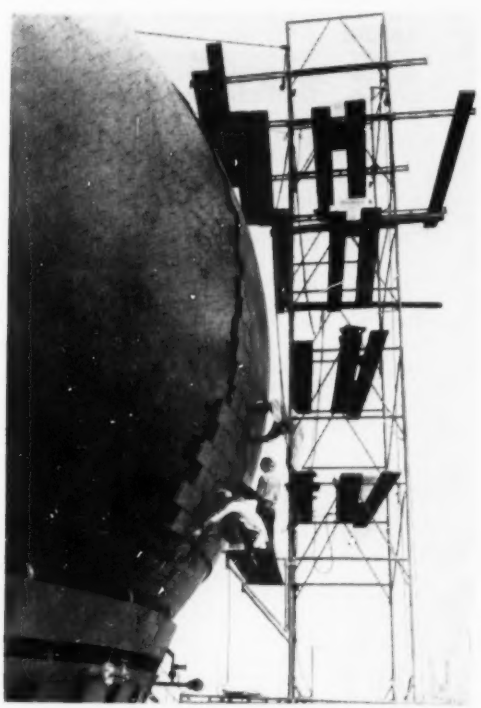


Fig. 9. A refinery spheroid being insulated with Foamglas. The blocks are impaled on the pointed studs and secured with clips

Fig. 10. Shows how insulation is impaled on studs once they are in position. Clips are then put over exposed stud ends to hold the insulation in place

Let's Put Dollar Signs on the Gas Turbine

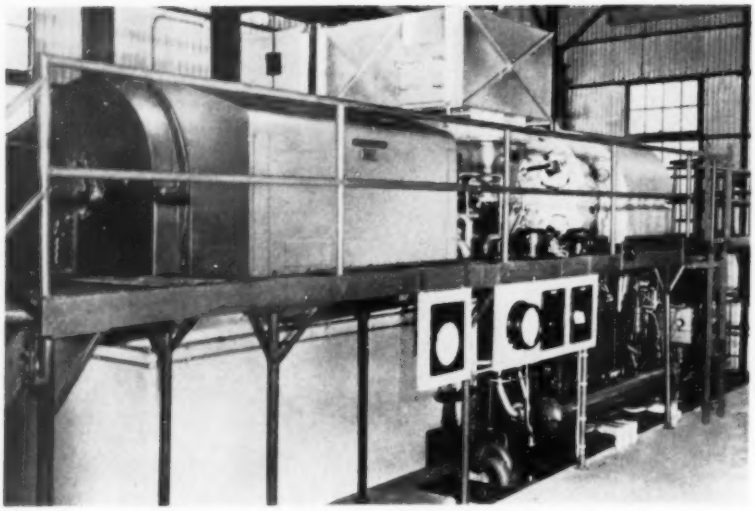


Fig. 1. Installation view of recent 5000-kw gas turbine generator at plant of West Texas Utilities Co.

By C. J. BURKE *

Here are some facts on the installed cost, operating cost and maintenance costs of gas turbines used for natural gas transmission, electric power generation, locomotives and mechanical drive applications

AT PRESENT, approximately 100 commercial gas turbine power plants, in the range of 1000 to 15,000 kw, are in operation or in process of manufacture in this country. These 100 plants represent approximately 400,000 kw (530,000 hp) of capacity. The initial commercial gas turbine power plants have been in operation about five years.

What is the economic justification for the appearance of this new type of power plant? Part of the answer at this very early stage of development is, of course, the fact that eagerness and enthusiasm have been substituted for economic evaluation in some cases. The vast majority of the new gas turbine plants were selected, however, because they offer distinct advantages which will mean a saving to the user.

The gas turbine power plants now installed or being manufactured are for one of the following four applications, listed in descending order of present magnitude of utilization:

1. Natural Gas Transmission
2. Electric Power Generation
3. Gas Turbine Electric Locomotives (Transportation)
4. Mechanical Drive — Process Purposes

In any type of evaluation and comparison between various plants, it is convenient to divide the economic advantages into three categories:

1. Installed Cost
2. Operating Cost (Both Labor and Supplies)
3. Maintenance Cost

* Gas Turbine Section, Application Engineering Dept., Westinghouse Electric Corp.

Let's see how gas turbine power plants offer economic advantages in one or more of the above categories.

Natural Gas Transmission

Economics of the gas turbine power plant for natural gas transmission are not all dependent on the characteristics of the gas turbine itself. In evaluating the gas turbine, it must be compared with the reciprocating engine on an over-all basis. Unlike the reciprocating engine, the gas turbine lends itself to driving a high-speed centrifugal or axial compressor for natural gas compression.

Figure 5 shows the first gas turbine power in the world to be used for natural gas transmission. The plant is rated 1800 hp at 8750 rpm.

The centrifugal natural gas compressor is capable of operating efficiently at lower pressure ratios and higher flows than a reciprocating type compressor. Reciprocating type engine compressor stations are usually spaced 75 to 100 miles apart and the gas is compressed between a compression ratio of 1.5:1 to 2:1. These high compression ratios heat the gas sufficiently to make it economical to cool it before returning it to the line in order to maintain line capacity. By reducing the station spacing, lower compression ratios are possible and the need for gas cooling eliminated. The horsepower necessary to transport a given amount of gas can be reduced 25 to 40 per cent with closer station spacing.

Several studies have been made to determine the installed cost comparison between the gas-turbine-driven centrifugal compressor and the conventional direct-driven reciprocating-gas-engine units. One study was made using these drives to fully develop a transmission line 1,000 miles in length. This study was based on the assumption that complete spare units would be available to maintain design flow capacity in the event of outage of one unit.

Figure 2 shows the comparison of transportation costs between a gas-turbine-powered line of 26 in. O.D. 11/32-in.-wall pipe and a reciprocating compressor powered line of 30 in. O.D. 3/8-in.-wall pipe. The gas turbine station spacing is approximately one half that of the reciprocating compressor station, and for the gas turbine powered 26-in. line, best gas delivery is approximately the same as that of a reciprocating engine powered line of 30 in. O.D.

Figure 3 shows the comparison of transportation costs between the 23 gas turbine stations on the 26-in. line and 11 reciprocating engine stations on the 30-in. line. The optimum annual delivery capacity for the two lines varies from 160,000,000,000 cu ft annually to 190,000,000,000 cu ft annually with the reciprocating compressor station showing an advantage above 186,000,000,000 cu ft due to the capability of the larger size line.

In summarizing this study, for a delivery capacity of 550 mmscf d (170,000,000,000 cu ft annually — 85 per cent load factor) a 26-in. O.D. pipe line with gas turbine centrifugal compressors required about $8,000,000 less capital investment, 64,500 fewer tons of steel and resulted in a reduced annual cost of about $1,360,-

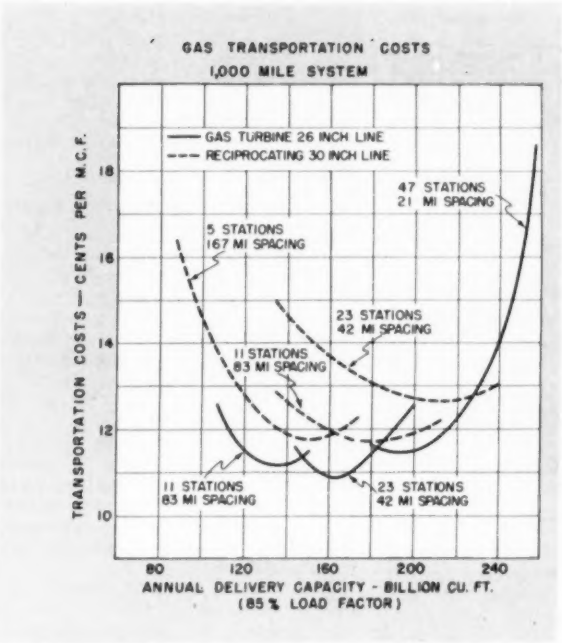


Fig. 2. Comparison of natural gas transportation costs between 26-in. gas-turbine-powered pipe line and 30-in. reciprocating-engine-powered pipe line

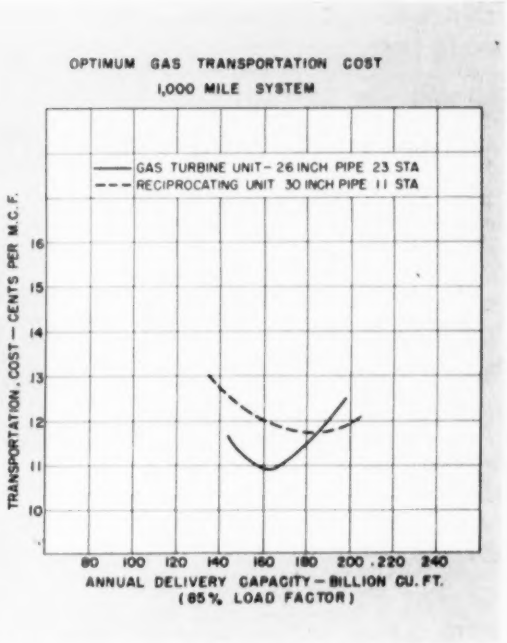

OPTIMUM GAS TRANSPORTATION COST
1,000 MILE SYSTEM
GAS TURBINE UNIT - 26 INCH PIPE 23 STA
RECIPROCATING UNIT 30 INCH PIPE 11 STA
TRANSPORTATION COST — CENTS PER M.C.F.
ANNUAL DELIVERY CAPACITY — BILLION CU. FT.
(85% LOAD FACTOR)

Fig. 3. Optimum natural gas transportation costs of 23 gas turbine station line as compared with the costs of the 11 reciprocating engine compressor line

000 or 0.8 cent per thousand cubic feet.

A second study indicated that the addition of centrifugal compressors in the 30-in. line between reciprocating stations would economically increase the capacity of this line from 550 mmscf/d to 670 mmscf/d.

As a result of various studies it appears that the gas turbine can be used economically to drive centrifugal compressors on natural gas transmission lines 20-in. in diameter and larger.

Electric Power Generation

Commercial gas turbine power plants for electric power generation are available in this country ranging from 1250 kw to 15,00' kw. The thermal efficiencies avai able range from 16 per cent for the simple open cycle to 26 per cent for the compound open cycle with intercooler and regenerator.

Figure 4 shows the plant thermal efficiency of various gas turbine cycles versus turbine inlet temperature. On the right, on block scales, are

Table I. Comparison of operating personnel for steam and gas turbine plants, for use in estimating

	Steam Turbine Plant	Gas Turbine Plant
Station Superintendent	1	1
Assistant Station Superintendent	1	0
Shift Operators and Reliefs	4	4
Firemen and Reliefs	4	0
Assistants and Reliefs	6	4
Totals	16	9

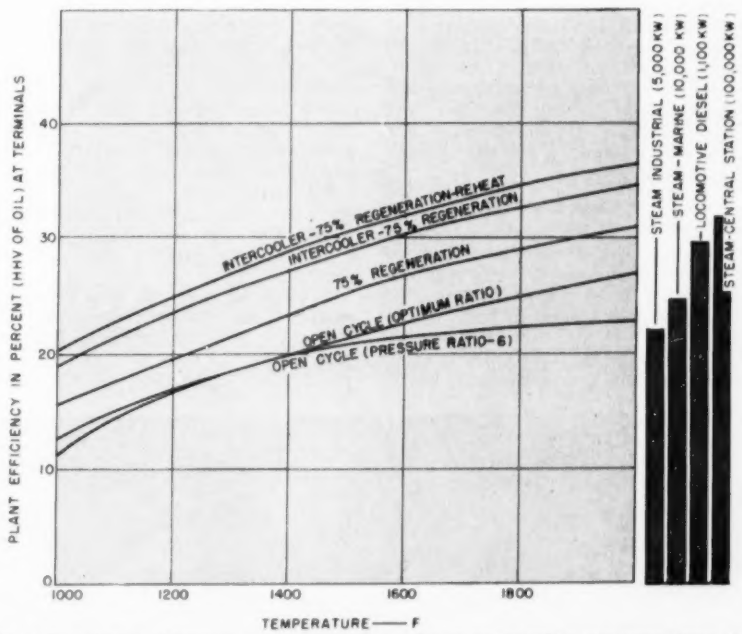

PLANT EFFICIENCY IN PERCENT (HHV OF OIL) AT TERMINALS
INTERCOOLER - 75% REGENERATION-REHEAT
INTERCOOLER - 75% REGENERATION
75% REGENERATION
OPEN CYCLE (OPTIMUM RATIO)
OPEN CYCLE (PRESSURE RATIO - 6)
TEMPERATURE — F
STEAM INDUSTRIAL (5,000 KW)
STEAM - MARINE (10,000 KW)
LOCOMOTIVE DIESEL (1,100 KW)
STEAM-CENTRAL STATION (100,000 KW)

Fig. 4. Plant thermal efficiency of various gas turbine cycles at various turbine-inlet temperatures. At right, typical efficiencies of various steam plants and a diesel locomotive, as discussed in detail in text

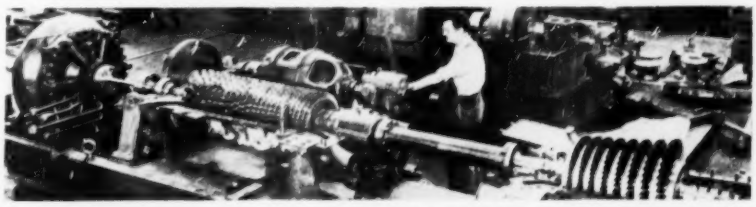
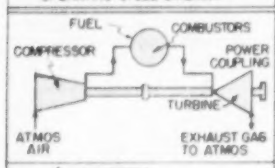
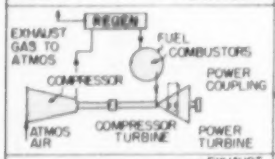
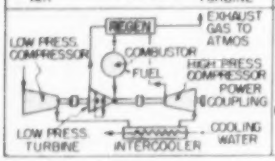


Fig. 5. Gas turbine plant for natural gas transmission: left, single-stage gas compressor; center, 23-stage axial air compressor; then combustors and 8-stage gas turbine, as discussed in detail in text

Table II. Operating cycles, plant designation, applications of Westinghouse gas turbine power plants

OPERATING CYCLE DIAGRAM	DESIGNATION	RATINGS AVAILABLE		APPLICATIONS
		FOR ELEC POWER GEN	FOR MECH DRIVE	
	SIMPLE OPEN CYCLE	1250 KW 5000 KW	1800 HP 7000 HP	BASE LOAD POWER GENERATION WHERE FUEL IS INEXPENSIVE. ELECTRIC PLANT FOR STAND BY, PEAKING, END OF LINE SERVICE OR IN SCARCE WATER AREAS. MOBILE OR SEMI PORTABLE PLANTS. PLANTS WHERE EXHAUST GAS CAN BE USED FOR FEED HEATING, STEAM GENERATION OR PROCESS
	COMPOUND OPEN CYCLE WITH REGENERATOR	3500 KW	5000 HP	DRIVE CENTRIFUGAL COMPRESSORS FOR NATURAL GAS TRANSMISSION. DRIVE PUMPS, COMPRESSORS, BLOWERS, ETC. — GENERAL INDUSTRIAL PLANTS ELECTRIC POWER GENERATION WHERE 3500 KW CAPACITY IS REQUIRED
 REGEN EXHAUST GAS TO ATMOS LOW PRESS. COMPRESSOR COMBUSTOR HIGH PRESS. COMPRESSOR FUEL POWER COUPLING LOW PRESS. TURBINE INTERCOOLER COOLING WATER	COMPOUND OPEN CYCLE WITH INTERCOOLER AND REGENERATOR	15,000 KW	20,000 HP	INDUSTRIAL AND CENTRAL STATION PLANT BASE LOAD OPERATIONS WHERE HIGHEST THERMAL EFFICIENCY IS REQUIRED

shown representative thermal efficiencies of several size steam plants and also a diesel electric locomotive. The present Westinghouse gas turbine power plants are designed for a maximum turbine inlet temperature of 1350 F and it is apparent that, from a thermal efficiency standpoint alone, gas turbine power plants cannot compete with steam turbine power plants. In all the comparisons which have been made, smaller fuel consumption and greater fuel selectivity are the only advantages of the steam turbine plant over the gas turbine plant. All other costs are decidedly in favor of the gas turbine type plant.

Cost Data

From the best available data it is estimated that the installed cost of a gas turbine power plant is approximately 80 to 90 per cent of that of a comparable steam turbine power plant.

The gas turbine is a simple rotating machine with semi-automatic starting and stopping and fully automatic protective features to protect against high turbine inlet temperature, low lubricating oil pressure, overspeed, excessive vibration, etc. These control features permit such minimum attendance that it is expected that gas turbine power plants used in future natural gas transmission compressor stations and possibly electric power generating stations will be remotely controlled via microwave communication systems.

Observations in a steam turbine power plant reveal that approximately 50 per cent of the operating crew is occupied full time in the operation of boilers, boiler feed pumps, combustion control, feedwater heaters and other affiliated equipment which has no counterpart in the comparatively simple gas turbine plant.

A detailed analysis was recently made of the operating personnel required for a 15,000-kw steam turbine plant and 15,000-kw gas turbine plant. Each plant is to contain three 5000-kw units. The gas turbine units are to be of the simple open cycle type. The results are given in Table I.

It is apparent that a gas turbine power plant will require only 50 to 60 per cent of the operating personnel required by a comparable steam turbine plant.

What About Maintenance Cost?

Since commercial gas turbine power plants have been in operation such a short time, data on maintenance costs are scarce and inconclusive. One economic approach is the selection of various parts of a gas turbine power plant, such as electrical switchgear, generator and the turbine proper, comparing their characteristics with their counterpart in the steam turbine power plant. The air compressor and auxiliaries mounted integrally with the gas turbine have no equivalent in the steam plant; neither does the reduction gear used with 1250, 3500 and 5000-kw gas turbine power plants.

The steam turbine power plant has many components which have no equivalent in the gas turbine plant. Such items are: boiler, combustion controls, air preheater, feedwater heaters, feedwater regulator, water treating and analysis equipment, forced and induced draft fans, evaporator, deaerator, boiler feedwater pumps, condenser, condensate pump, water intake, cooling and circulating system plus eight or ten complete piping systems, each with its valves, indicators, controls, etc.

Such a large part of the maintenance cost is attributable to this portion of the steam turbine plant, for which there is no equivalent in the gas turbine plant, that if the maintenance of each part of a gas turbine plant were several times that of its steam counterpart, the total for the gas turbine plant would still be a small fraction of the total for the steam plant. Following this line of reason, it can be expected the maintenance cost of a gas turbine power plant will be less than that of a comprable steam turbine plant.

Figure 1 shows an installation view of typical 5000 kw, simple open cycle, gas turbine power plant. This gas turbine power plant has a full load thermal efficiency of 18.0 per cent, requires approximately 350 gpm of cooling water and can be installed at a total cost of approximately $175 per kw. The complete 5000-kw gas turbine power plant is being operated with one superintendent and five operators. This allows one man per shift for the entire station. This plant is economically suited for high load factor, low fuel cost operation or low load factor, high fuel cost operation. Also suitable for applications where waste heat in the exhaust gas can be utilized.

The Westinghouse-Baldwin demonstrator gas turbine locomotive was the first gas *continued on page 116*

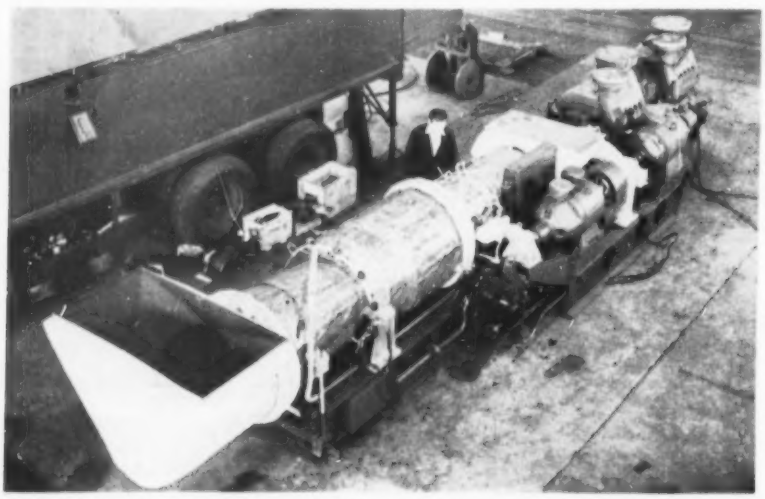


Fig. 6. Mobile-type 1800-hp gas turbine driving tandem air compressors. Trailer is shown in background

New Wilmington Power Plant Installs Quarter-Mile Plastic Pipeline

Fig. 1. An ordinary handsaw can be used to cut a plastic pipe. Here the last length is being cut

Fig. 2. Reinforced concrete conduit protects the pipe from crushing loads where it passes beneath rails. The conduit was placed, then pipe run in

CORROSIVE WELL water, saturated with air and containing a high percentage of CO_2, will flow to the new Wilmington Steam Electric Generating Plant of Carolina Power and Light through a 3-in. butyrate plastic pipeline this year. The first 100,000-kw unit of the Wilmington plant is scheduled to go into operation in 1954, and the second in 1955.

One of the first industrial installations of its kind, the pipeline will run over one quarter of a mile from the well to the tanks in which the water is to be degassified. Both air and CO_2 are removed at this stage and the water is used for all station facilities which require it.

Cemented Joints

Extruded of butyrate plastic, the pipe has an inside diameter of 3 in. and comes in 20-ft lengths. These lengths are joined together by slip-sleeve couplings and a solvent cement which is painted onto all mating surfaces. When joined with the cement, adjacent lengths are in effect welded together by the fusion induced by solvent action. No threading was required in either the couplings or pipe, and this resulted in considerable savings in installation time. It is said that the plastic pipe cost only half as much as the alternate material, red brass pipe.

Pressure in the line will be about 50 psig. Before it was buried (to a depth of 30 in.) it was satisfactorily pressure-tested to 70 psig. Dirt was placed directly on the pipe except where it ran beneath railroad tracks, and here it was carried inside a reinforced concrete conduit for safety.

Butyrate Properties

Researches conducted on various plastic pipe materials by Batelle Memorial Research Institute indicate that cellulose acetate-butyrate, a semi-rigid thermoplastic, has a strength ranging from 6000 psi to 3600 psi over a temperature range of 77 F to 158 F. It is not affected by weak acids and alkalies, but strong acids and alkalies will cause decomposition. Also, while alcohols soften butyrate, hydrocarbons effect it very little. It is this last characteristic which has led to its greatest application thus far; i.e., oil field gas and oil pipelines.

Butyrate pipe has been used to transmit brine as well as oil and gas in the oil fields, but it is especially adapted to the transmission of paraffin crudes. Paraffins tend to precipitate and build up in metal and concrete pipe, but cannot adhere to the smooth plastic walls. When butyrate pipe is used to replace corroded gas lines, the old line can be used as conduit for the new and excavation charges minimized.

The 20-ft lengths of 3-in. butyrate pipe weigh only 23 lb each, and can be carried easily by one man. This ease of handling contributed to the record installation time for the Wilmington job; more than a quarter of a mile of line in less than one day.

Fig. 3. Solvent cement joins lengths of butyrate plastic pipe inside the slip-sleeve coupling. Water could be pumped through the pipeline in minutes

Fig. 4. One man easily lowers the pipe into prepared ditch 30 in. deep. The quarter-mile of line was completed in less than one day and pressure tested

Here and There With the Editor

By A. W. KRAMER*

THE Winter General Meeting of the American Institute of Electrical Engineers, always held in January and usually in New York City, is one of the outstanding events of the year in the world of electrical engineering. It is at this meeting that electrical specialists from all over this continent gather to discuss progress in the electrical art and where many of the world's greatest achievements in electricity have been first announced.

My attendance at these winter meetings probably constitutes some sort of a record for it has been my privilege and good fortune to have been able to attend every one of them since 1922. Looking back over those 32 years, what I remember most about these meetings perhaps are the great and distinguished personalities who were honored at these gatherings — Robert Millikan, Frank Jewett, William Coolidge (x-ray tube), Charles F. Scott, Michael Pupin (telephone loading coil), Guglielmo Marconi, Ambrose Swasey, Arthur Kennelly (Kennelly-Heaviside layer), Alex Dow, Lee deForest, Joseph Slepian. These are only a few, but their stature is indicative of the eminence of the others.

Fig. 1. At the AIEE meeting. A. C. Montieth, presidential nominee, witnesses presentation of the Edison Medal to J. F. Peters, consultant to Westinghouse, by AIEE President Elgin B. Robertson

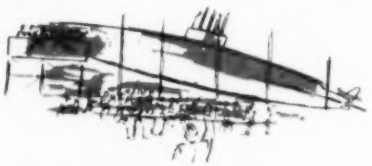
In 1942 we presented the Edison Medal to Edwin H. Armstrong, the world's greatest inventor in the field of radio, whose tragic suicide was reported recently in the newspapers.

While the general flavor of these winter meetings has not changed greatly through the years, their size and organization has. In the early years they were always held in the old Engineering Societies Building on 39th St. but they have long outgrown the facilities of that once spacious headquarters and in recent years they have been held at the Statler Hotel. This year, however, with an attendance of almost 5000 and almost a hundred technical sessions at which some 300 papers were presented, even the usually ample facilities of the Statler proved inadequate and the overflow was handled at the McAlpin Hotel. One wonders whether this is good or bad. Mere size is not always a blessing and the organization and the handling of these meetings is becoming more and more of a problem.

The papers, of course, ran the whole gamut of interest in the electrical field, ranging from the latest designs of 250,000 kw turbogenerators to what is happening in the transistor field. Small as it is physically, the transistor seems destined to give the turbogenerators a run for their money; it looms up as a development of greatest significance on the horizon of future development. The new surface-barrier transistor developed by Philco and described at the meeting by W. H. Forster promises to make possible the mass production of standardized transistors, something which, so far, has not been realized.

The nomination of A. C. Montieth, vice-president in charge of engineering of Westinghouse, as the 1954–55 president of the Institute was announced toward the close of the meeting. This well-deserved honor to "Monty" comes as welcome news to all his many friends and he brings to the Institute not only his broad experience in the engineering field with Westinghouse but also his intimate knowledge of Institute affairs extending back to his student days.

The AIEE meeting took the entire week of January 18 but I took time off on Thursday, January 21, to run up to Groton, Conn., to attend the launching of the *Nautilus* to which I had received an invitation. This was a momentous event, not so much for what we saw but for what it signified — not only the achievement of the first atomic powered submarine but, even more important, the development of the world's first working atomic power plant. Externally, of course, the *Nautilus* looks much like other submarines — a little larger perhaps, but inside of her steel hull is a power plant the like of which the world has never seen before. And it works! Last summer, I had the privilege of inspecting the Mark I, that is, the prototype of the plant of the *Nautilus* at the U. S. Atomic Energy test site out in Idaho.



Some features of the Mark I are shown on page 82 of this issue. It was like something out of this world, to see, out on the Idaho desert, miles away from anything, a full size submarine, with the reactor portion of it actually in a large tank of water. Now, you may wonder, among other things, where they got so much water out on the Idaho desert. Well, the answer is quite simple; that part of Idaho is mostly of a volcanic nature, and underneath the lava surface, in certain places subterranean lakes have formed, the water being carried in by underground streams. So the water is no mystery. At the time of my visit, the atomic power plant had actually been in operation for some time, the energy of the

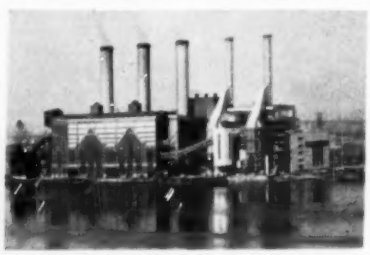


Fig. 2. (Above) The new extension to Kearny Station shown at the right, operates at the highest steam pressure and temperature in the world

Fig. 3. (Left) Gordon Dille of Westinghouse, L. W. Lemon, Assistant Mechanical Engineer, PSE & G Co., and A. W. Kramer, Editor, POWER ENGINEERING, at the Kearny extension inspection visit

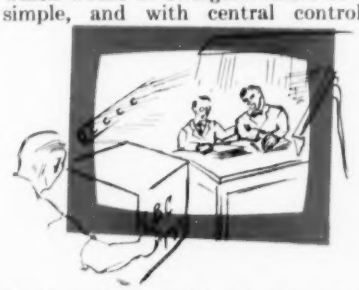
*Editor, POWER ENGINEERING

propellers being absorbed in a water brake. There is, therefore, no reason to doubt that the *Nautilus* will be a success. More than that, her power plant will serve as a model for the first civilian nuclear power plant to be built by the AEC.

Of outstanding interest the week following the AIEE meeting in New York was the technical press inspection visit to the new extension of Kearny generating Station of Public Service Electric and Gas Company near Newark, N. J. The two 145,000 kilowatt boiler-turbine-generator units which comprise this new section operate at the highest steam pressure and temperature in the world. The two Combustion Engineering boilers operate to produce steam at the turbine throttles at 2350 psi and 1100 F. Unusual features of these units include controlled circulation, pressurized firing, twin furnaces, flue-gas recirculation and the use of either coal or oil.

After a preliminary briefing on the highlights of the station by the officers and engineers of the company, the editors were taken through the station in small groups, giving ample opportunity for questions and detailed discussion with the designers. Of particular interest, especially, to the non-technical newspaper men, were the two stainless steel main headers carrying the high-pressure steam from the boilers to the turbines. These 9-inch pipes with walls $1\frac{1}{2}$ inches thick, 80 ft long, forged and bored just like gun barrels, we were told, cost $800 per foot. Beneath the insulation covering these headers, the steel glows a dull red as the high temperature steam flows through them at a speed of some 15,000 ft per minute — 170 miles per hour. Those of us familiar with modern high pressure steam station development, of course, were familiar enough with this fact, yet it was somewhat startling and astonishing to look into a small heat resisting glass peephole fitted into the insulation, and actually see the red hot metal inside. And then, when one stopped to reflect that not only this entire pipe from boiler to turbine but also the whole front end of the high pressure turbine itself also was red hot, the achievement was even more astonishing.

The two General Electric single shaft, 3600 rpm turbogenerators are rated at 147,500 kva, 137,500 kw in the main generators and 10,000 kw in the auxiliary generators which are on the same shaft. These machines operate at 30 psi hydrogen pressure and generate at 20,000V. Streamlined to the last degree and painted in harmonizing colors, these beautiful machines are a delight to the eye as well as a comfort to the economist, since they are among the most efficient in the world. As F. P. Fairchild, the Chief Engineer of PSE & G Co. put it, the objectives in the Kearny design were to achieve a plant design which would be straightforward and simple, and with central control



which would simplify operation and require minimum operating effort.

After inspecting the station in the morning, the guests were taken back to Newark for a reception and luncheon, all of which was very enjoyable. Much credit is due Joseph A. Gallagher, Director of Publicity of PSE & G, and his associates for the excellence of the arrangements which contributed so much to the success of this party.

Flying from New York to Toronto, Canada, via American Airlines to deliver an address on the subject of Atomic Power before the Association of Professional Engineers of Ontario at its annual luncheon on January 29, I was met with a welcome that reflected the good feeling that exists between our respective countries. To one who has been vitally interested in the development of nuclear energy for a period of 15 years, the growing interest in the question of atomic power for peace is heartening. Over 1200 engineers attended this luncheon, and the newspapers and radio stations covered my speech in considerable detail. Indeed, I had scarcely got settled at the Royal York Hotel when I was asked to give a television interview. It was ten minutes to six then and the telecast was set for 7 P.M. With the broadcast station several miles away, and with snow a foot deep, not to mention a traffic jam, it required fast work on the part of those who arranged the telecast to get me there intact but it all went off without a hitch.

Fig. 4. Editor Kramer of POWER ENGINEERING addressing the annual luncheon meeting of the Association of Professional Engineers of Ontario at Toronto, Canada

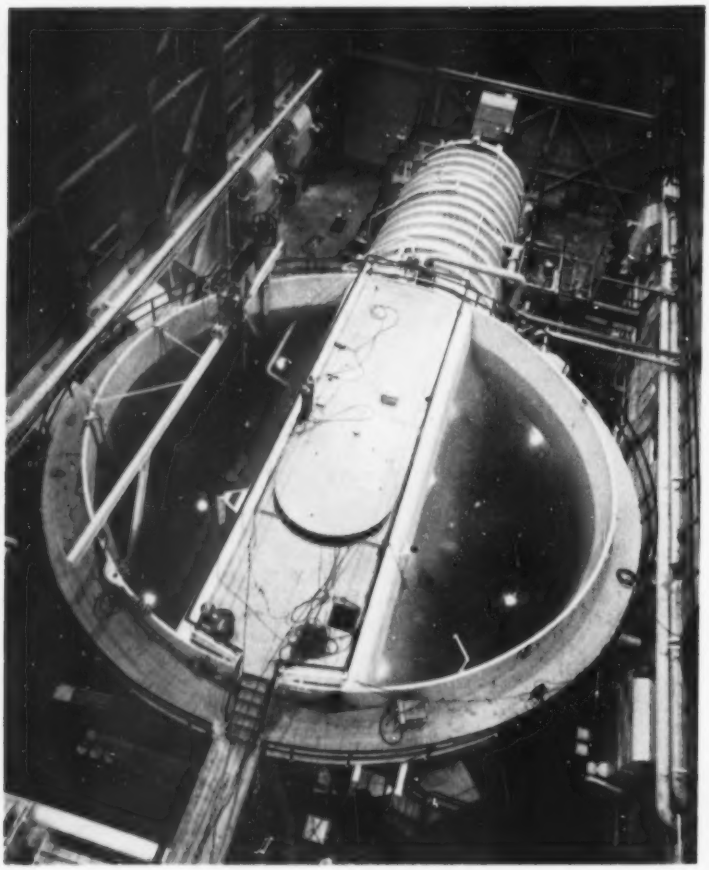
Fig. 5. The Toronto meeting was attended by over 1200 professional engineers from the Province of Ontario

Fig. 6. The *Nautilus* a few minutes after the submarine's launching at Groton, Conn.

Power Engineering's NEWS REEL

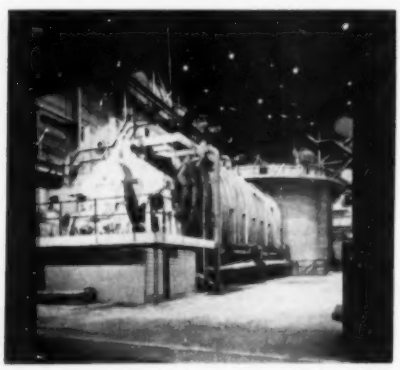
Visits the Power Plant of the FIRST ATOMIC SUBMARINE

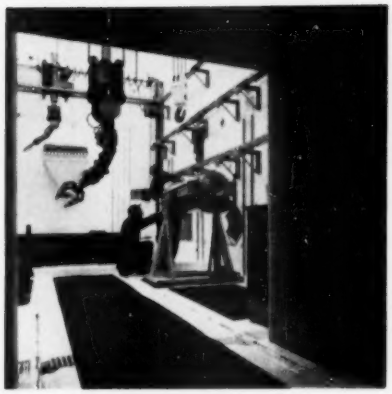
Photos courtesy Westinghouse Electric Corp.



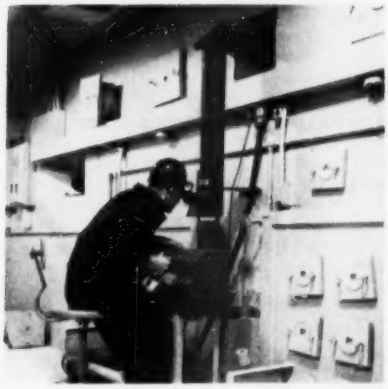
Mark I, the first submarine nuclear power plant, is housed in this simulated submarine hull. The reactor section is surrounded by water within the "sea tank" (above) which holds about 385,000 gal. The tank is 50 ft in diameter and nearly 40 ft high. Aft end of hull (right) is seen through largest door in the main assembly building; note the life savers mounted on rail. Power plant was completely assembled and tested in hull, and similar unit (called Mark II) was installed in the *USS Nautilus*. Power developed by the prototype unit is absorbed by a large water brake dynamometer (in aft view)

Concrete slabs bolted to a steel framework form a functional structure housing the world's first atomic submarine power plant in the Idaho desert. Air pressure is maintained inside the building to exclude dust. Stacks on roof can exhaust 36,000 cfm each in crisis

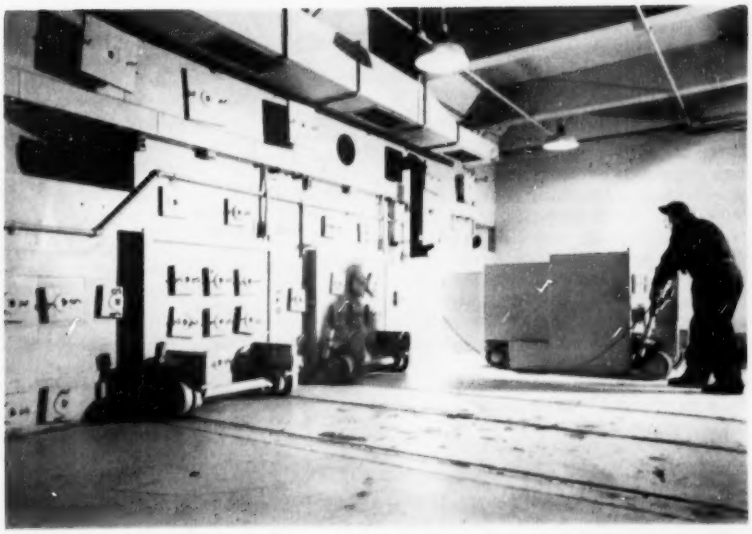




Dangerous radioactivity does not harm this mechanical hand (left) even when it is working in a "hot cell" (above). Cell above is not contaminated, but if it were the operators would manipulate the mechanical hands from outside (below)



Closing a 4-ton door to the "hot cell" (right) is accomplished with an electric drill drive. The door, like the walls, is 7 ft thick and is made of concrete and steel. Small square ports are for insertion of small objects in cell



H-T Water Gives Low-Cost Heat at Twenty-nine Palms

In the system, seven oil-fired area boiler plants supply hot water at 100 psig, and 338 F, to heat marine training base at Twenty-nine Palms, Calif., divided for flexibility in occupancy of areas. Buildings heated and cooled by evaporative coolers; converters supply 25-psi galley steam. Labor cost 20% less, equipment 13% less, maintenance 60% less than comparable steam heating system

By J. P. HARRINGTON *

THE BASE at Twenty-nine Palms is located some 40-odd miles northeast of Palm Springs, California, where temperatures range from 12 F. to 110 F. and humidity conditions are relatively low the year round.

The site selected now accommodates over 120 permanent type buildings, with complete living facilities for approximately 7,500 men. Topography of the camp site is a sloping plane between low mountains on one side and a dry lake on the other. The site was developed with a rectangular grid system for roads approximating the original ground levels, with cuts and fills to provide stepped planes for six battalion areas, parade grounds and other operational buildings; thus nearly all buildings are set at varying elevations.

Flexible Area Layout

Because the base was divided into seven separate areas, it was decided that each area should be designed to function as a unit, thereby making it possible for any one of the seven areas to be deactivated without affecting the others.

This brief description of the general layout is given to point out the inherent difficulties that at first seemed to preclude the feasibility of considering central heating for this project.

By directive, evaporative cooling was required for all buildings except storehouses and maintenance buildings. This, from an economical viewpoint, limited the individual heating units to gas-fired duct furnaces or blast coils fed from a central plant. Natural gas was not available and gas equipment would necessarily have to be fired with LPG (liquefied petroleum gas).

Due to the irregularity of the terrain, operation from a central steam distribution system would have required high stanchion pipe supports, and in each of the areas, at least 12 drip-trap assemblies on the supply main and an outlying condensate pump. All this, in addition to the auxiliary equipment of the steam plant itself, made this central type of plant impractical from the standpoint of initial cost as well as maintenance.

Central Hot Water Vs Steam

At this stage it might be well in a general way to tabulate the equipment requirements of a central steam plant compared with a central high-temperature water plant to clearly define the dictates of economy.

STEAM PLANT	H-T WATER PLANT
Boiler	Boiler
Deaerating Feedwater Heater	Circulating Pumps
Feedwater Storage Tank	Water Softener (Small)
Boiler Feed Pumps	
Blow-Down Tank	
Feedwater Regulator	
Water Softener	

A similar comparison for the main distribution system for one battalion area would be as follows:

STEAM	H-T WATER
10,000 Ft Std. Pipe—6"–1¼"	10,000 Ft Std. Pipe—5"–1¼"
40 Valves (Bldg. Shut-offs)	40 Valves (Bldg. Shut-offs)
12 Drip Trap Assemblies	14 Air Vents
1 Cond. Return Pump	
1,200 Ft Pump Return—2½"	
Additional Pipe Supports and Insulation	

Tabulation of operational losses was made to complete the comparison.

STEAM PLANT	H-T WATER
6% Radiation Loss	4% Radiation Loss
3% Blowdown, Soot Blowers, B.F. Pumps	1% Soot Blowers
10% Valves, Traps, Leaks, Flash Steam	1% Valves, Leaks
19%	6%

Assuming a boiler efficiency of 80 per cent in each case, the overall efficiency of the steam system would be 64.8 per cent as against 75.2 per cent for h-t water. This would indicate that the h-t water system operates at a fuel saving of 10.4 per cent.

Hot water from central plants seemed to best meet the requirements of irregular terrain, initial cost, operation and maintenance. The distribution mains could follow the contour of the ground and be supported on stanchion supports of minimum height and with no trap assemblies or outlying pumps, maintenance would be minimized and more or less restricted to the confines of the boiler plant itself.

H-T Water Selected

It was decided to go one step further and provide hot water plants that would meet all the requirements of the areas not only for heating but also for domestic hot water. In the Administration area, requirements for galley steam are also included. To accomplish this meant operating the plant at temperatures and pressures in excess of those normally used. From an economic standpoint this worked out very favorably, because, as the temperature of the supply water was increased, the size of the supply mains decreased and consequently the initial installation cost was lessened. The operating temperature finally determined for this project was 338 F. at a pressure of approximately 100 psig with a temperature drop of 100 F for the system.

Housing for the boiler plant was provided by the simple expedient of a single bay extension of the Messhall galley in each area as indicated in Fig. 3. Thus each battalion area, consisting of 16 Barracks, one Administration Building, one Mess Hall and two Instruction Buildings, is self-sufficient and may be activated or deactivated as the occasion arises without affecting the other areas.

* Mechanical Engineer, Harrington & Bradford, Consulting Engineers

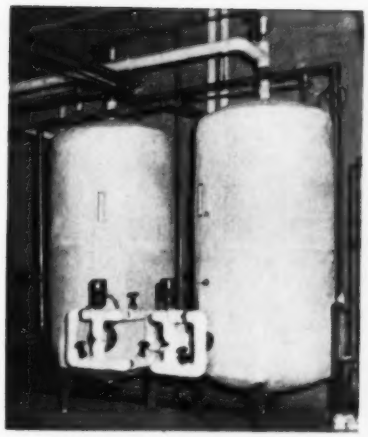


Fig. 1. Hot water for galley use is generated in these heater units by the high-temperature water

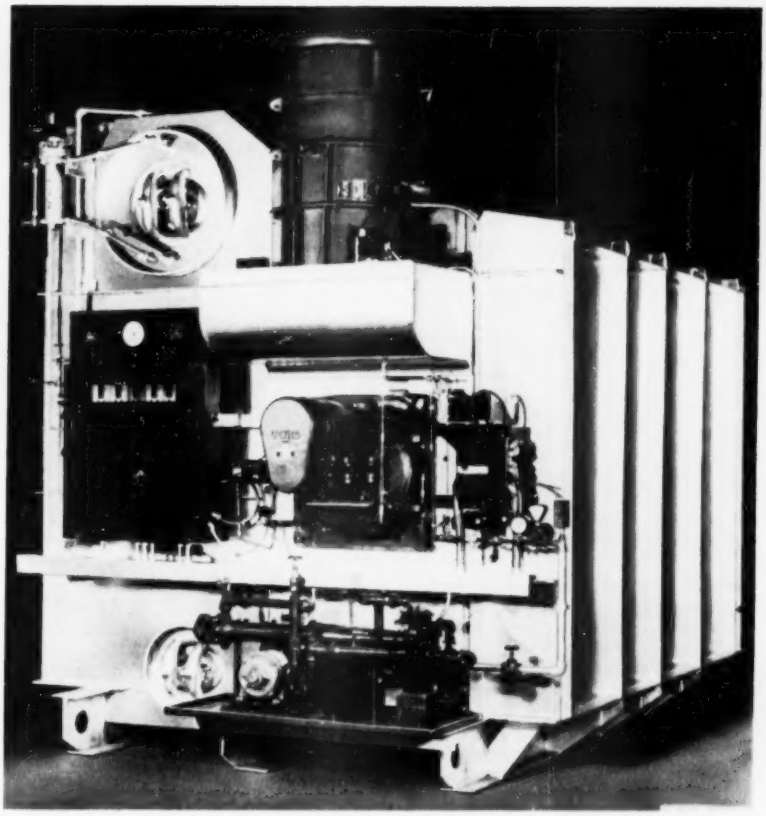


Fig. 2. Oil-fired package boiler, one installed in each of seven areas, with one standby in three areas

For complete flexibility, standby capacity was provided for three battalion areas on each side of the grid. This was accomplished by the addition of an extra boiler in each middle boiler plant to serve as a standby for any of three identical battalion areas.

Interconnections and Load

The three boiler plants each side of the grid are interconnected by piping. The seventh area, which contains Officers Mess, Quarters, Administration, Dispensary, Dental Clinic, Communications, etc. was supplied with its own standby boiler, since it was too remote to be economically tied in with the battalion areas boiler plants.

During the winter months, domestic hot water heating constitutes roughly one-half the total load demand. Throughout the summer months, any one of the boilers on one side of the grid is adequate for the total domestic water heating demands of all three battalion areas on that side, due to the reduction in water temperature differential.

Simple Flow Diagram

The system as a whole is quite simple. Referring to the flow diagram, Fig. 4, hot water is generated in the boiler at approximately 100 psig and circulated through a reverse return system to all buildings in the area. In the Administration-area boiler plant, galley steam at 25 psig is generated in a convertor by means of the high-temperature water. Domestic hot water for galley use is generated in standard hot water generators also by means of the high-temperature water.

Figure 1 shows typical generators with their simplified connections. At each building, the take-off from the main serves the domestic hot water generator in that building at 338 F. and also, by means of a separate loop at 270–250 F., serves the hot-water coil or coils installed as a part of the heating and cooling system.

Heating and cooling system for

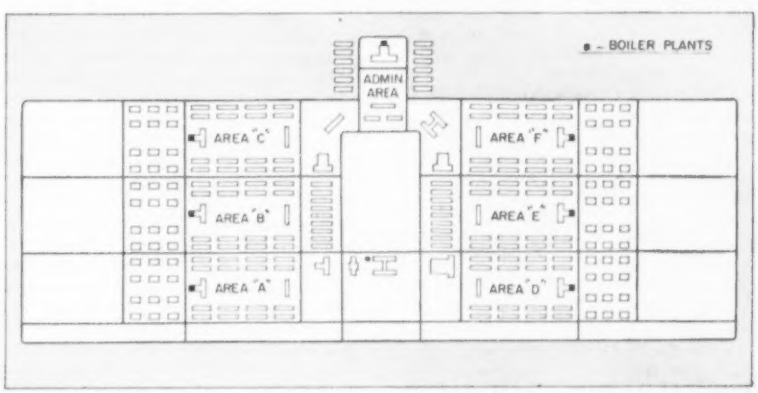


Fig. 3. General plan of Twenty-nine Palms Marine Training Base, showing relations of six battalion areas

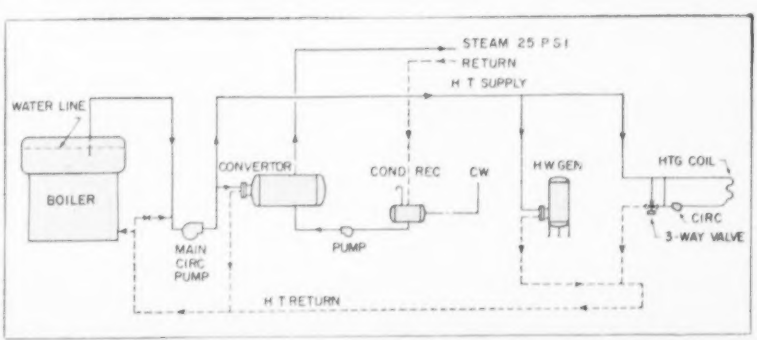


Fig. 4. Flow diagram of system in Administration-area shows how h-t water supplies the various services

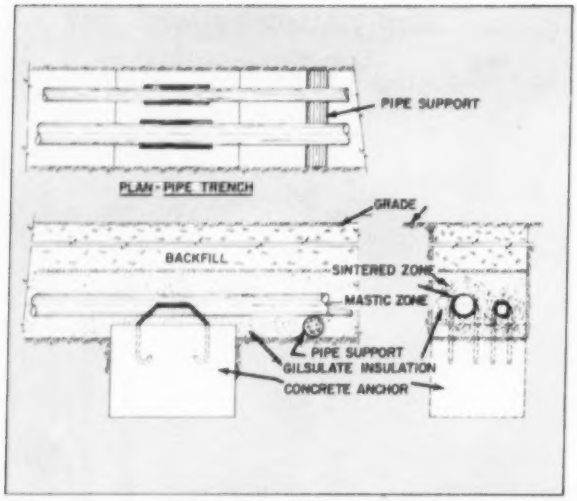


Fig. 5. Details of hot water distribution piping system, showing method of supporting and insulating the pipe. Installation method described in the text

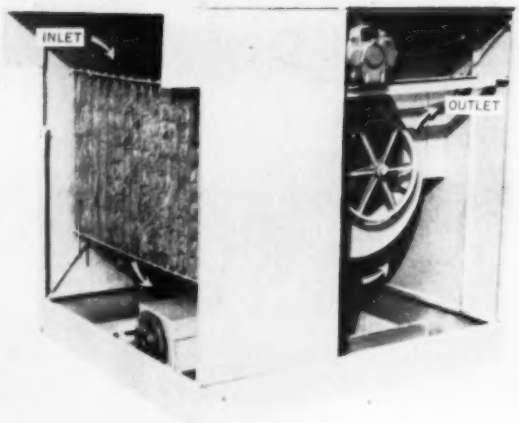


Fig. 6. Evaporative coolers like this using parallel glass fiber pads, supply the individual buildings, each building being thermostatically controlled

each building consists, in general, of evaporative coolers, Fig. 6, with two-speed blower motors, hot water coils, distributing ductwork with proportional extractors at each outlet, return ductwork for winter operation and relief openings for summer operation. Each building is thermostatically controlled by 3-way modulating valves and venting of lines within buildings is completely automatic.

Wherever possible, all equipment is suspended within the building from the roof structure. Adequate headroom is maintained and no usable floor space occupied. Fresh air intake, exhaust and relief openings are in the side or end walls.

The main distribution piping, for the most part, is supported on stanchion supports or suspended from the overhang of the buildings. Where it crosses roads or access areas, the piping is run underground.

Boiler Plant Details

Bunker C oil was selected as the fuel for the boiler plants and this is stored in underground tanks at each plant and maintained at temperature of 110 F. by circulating a portion of the high-temperature water return through submerged coils in the tanks. A thermostatically-controlled motorized valve with bulb in the oil suction line controls the fuel oil temperature. This valve is electrically interlocked with the circulator.

In general, selection of plant equipment is dependent only on the operating characteristics of the system, which are in turn determined by the pressure and temperature ratings of the equipment served and the extent of the distribution system to serve that equipment. However, in this particular instance standard boiler and auxiliary equipment and materials were used, all in the interest of increased efficiency and reduced cost.

The boilers installed, Fig. 2, were standard two-drum, bent-tube, package units, the eight larger units having an output of 17,400,000 Btu per hr and the two smaller units, 11,700,000 Btu per hr at 330 F., complete with full steam trim, manufactured by the Springfield Boiler Co. These boilers were designed for the particular service in that a forced-circulation first stage was provided and a water expansion of steam space maintained by water level control and internal baffling.

The first-stage forced-circulation is arranged so that, if interruption of flow in the supply mains should occur, the boiler can operate under natural circulation by a safety provision designed into the internal baffling, which will permit feeding of water from the boiler section into the water-wall sections during the time that no water is being returned to the boiler.

The internal baffling in the steam drum is arranged so that at no time can steam be siphoned out of the drum. This is further assured by having some of the return water discharged in the section where the hot water is taken out of the drum.

Since the plant has been put in operation, it has been determined that the water level does not vary during high and low-load operation or load swings; the water temperature does not vary and the thermal efficiency of the plant approaches 84 per cent.

Water Distribution System

Where distribution mains cross under roads they are encased in Ric-Wil insulated conduit with drip collars installed at each end above grade. For underground pipe protection and insulation, Gilsulate was used. This is an asphalt-like hydrocarbon in granular form.

In this instance, the pipes were supported on sections of concrete-filled cement asbestos pipe laid crosswise of the trench on 10-ft centers. Then Gilsulate was poured around the pipe so as to surround it on all sides to a thickness of 4 to 6 in. depending on the size of pipe involved. The Gilsulate was then tamped lightly and the trench backfilled. Details of installation are shown in Fig. 5.

When the mains are heated up, the heat fuses the material in contact with the pipe to form a plastic coating. This coating, 0.5 to 1 in. thick, will permit the pipe to expand and contract as the temperature rises or falls. Beyond this inner coating, the material grades outwardly into a sintered zone, about 3 in. thick, that is impervious to moisture and gives excellent thermal insulation.

To safeguard against electrolysis, the underground pipe anchors were constructed of reinforcing rod welded along the pipe for several inches with rod ends hooked and anchored in a concrete block. The bottom of the pipe was held within 2 in. of the concrete to assure that all portions of the reinforcing rod were encased within the waterproof sintered zone of the insulation.

Evaporative Coolers

For the heating and cooling systems within the buildings a new type of evaporative cooler was adopted. To assure a constant supply of air to the building at all times it was necessary to find a cooler that would not become blocked with dirt and lime and thus impede the passage of air. The cooling media of the successful subcontractor, The Consolidated Mfg. & Sales Co. is a series of parallel glass fiber pads placed in the air stream parallel to the direction of air travel.

The long travel distance of the air over the wiping area of the pad accomplishes the necessary cooling. Pads are placed about $1\frac{1}{2}$ in. apart and since no accumulation of dirt or lime can block these spaces, the air flow through the cooler remains constant. Figure 6 shows construction details of

continued on page 116

American Power Conference Meets March 24-26 in Chicago

AMERICAN Power Conference will hold its 16th annual meeting March 24, 25 and 26 at the Sherman Hotel in Chicago. The conference is sponsored by the Illinois Institute of Technology in cooperation with twelve universities and ten local and national engineering societies. E. R. Whitehead is Secretary, American Power Conference, Illinois Institute of Technology, Technology Center, Chicago 16, Illinois. This Conference is still the only national engineering meeting in the country devoted solely to the problems of the power field.

The Conference Luncheon Wednesday noon will be addressed by Walter H. Sammis, who will speak on The Power Industry — A Challenge to Engineers.

Important feature of the meeting will be Light's Diamond Jubilee dinner at 7:00 P.M. on Wednesday, March 24. Speaker at this dinner will be C. H. Moses of Arkansas Power and Light Co.

The All Engineers Dinner will be held Thursday evening, March 25; the speaker will be Jerome K. Kuykendall, Chairman, FPC.

As might be expected, many papers will be given on the problems of utility and industrial steam boiler plants. Wednesday afternoon, March 24, in a session on central station steam generation, Performance of New Controlled-Circulation Boilers will be treated by E. M. Powell; Cyclone-Furnace-Fired Boilers by George W. Kessler; Pulsation-induced Vibration in Utility Steam Generating Units by Raymond C. Baird. Present and Future Status of the Fly Ash Disposal Problem will be covered by C. M. Weinheimer.

A simultaneous industrial plant session will hear Scale Modeling discussed by James A. Carroll, also Selection, Maintenance and Piping Practice in Industrial Plants by Robert J. Pinske. Hans Ederegger Jr. and M. W. Stehr will cover Planning and Installing an Electrical System in a Rapidly-Growing Industrial Plant.

On Thursday morning, Central Station Steam Turbines will be discussed, beginning with a paper on Steam Turbine Development by Clarence C. Franck and another on Trends in Design of Present Day Steam Turbines by Charles D. Wilson. The Steam Turbine of Tomorrow will be covered by R. S. Neblett.

On Thursday afternoon, March 25, the Fuel Economies Session will hear Richard Gonzales discuss Economic Trends in Use of Natural Gas. George A. Lamb will talk on Future of Coal in Power Generation and W. F. Friend on Nuclear Fuels for Power Generation.

On the same afternoon, Economic Factors of Industrial Power Plants will be covered. Gerald J. Matchett will talk on Economic Factors Affecting Selection and Replacement of Power Plant Equipment, and C. E. Morrow and R. F. Born will talk on Hawthorne Power Plant Rehabilitation Economics.

On Friday morning, March 26, the Gas Turbine session will hear T. J. Putz discuss Gas Turbines for the Power Industry and Louis S. Gee describe a New Power Cycle Combining Gas Turbines with Steam Turbines. In an afternoon session, Performance of 2400 HP Trainmaster Diesel Locomotives will be discussed by Robert Aldak and use of Gas Turbine Electric Locomotives on the Union Pacific Railroad by F. Fahland. Factors associated with Use of Gas Turbines for Automotive Applications will be given by John H. Bonin. Gas Turbines in the Steel Industry will be described by George H. Krapf.

On Friday afternoon, at the Industrial Steam Generation session, Some Economic Factors Influencing Industrial Boiler manufacture will be presented by Carl E. Miller. Operating Experiences with a Multi-Fuel Stoker-Fired Boiler will be told by G. G. Bachman, while Leo L. Moran will discuss Industrial Operating Experience with Cyclone-Fired Boilers.

Thursday morning there will be a Distribution Systems session, including a paper by R. E. Pierce and W. R. Bullard and Chase Hutchinson on Electric Distribution for Future Loads. Adequate Wiring for Appliance Loads will be discussed by L. G. Smith.

In the Electrical Systems session on Thursday afternoon, Constantine W. Bary will describe Load Structure of a Modern Electric Utility System and W. J. Lyman and V. E. Hill will present Service Standards in Relation to Reserve and System Design.

That meeting will be followed by another on Cables for Transmission and Distribution. Here H. M. Bankus and F. C. Van Wormer will discuss Aerial Cable for Distribution Systems and K. S. Wyatt will present a paper on Aluminum for Underground Cable Sheaths.

On Friday afternoon, Operating Experience with Microwaves in a Power System will be given by Emerson A. Shultz and Herbert G. Goers and there will be another paper by unannounced authors on Power Line Carrier Applications.

This meeting will be followed by one on Circuit Breakers in which High Voltage Airblast Breakers for High Interrupting Capacity will be covered by Hans Meyer and Werner R. Streuli. Paul Wildi will then discuss Modern High Voltage Circuit Breakers with Low Oil Content.

On Friday afternoon there will be a symposium on Network Analyzers and Computing Aids and a simultaneous session on Electric Circuit Breakers. In this session, Recent Developments in Large Power Circuit Breakers will be covered by A. W. Hill, Trends in Design and Application of Tank Type Power Circuit Breakers by L. J. Linde and A. E. Kilgour and Switchgear Equipment for Super Voltage Transmission by R. M. Bennett.

A session on Nuclear Energy on Friday will hear Donald H. Loughridge discuss Economic Aspects of Various Types of Nuclear Reactors. Technology of the Use of High Pressure Water for Reactors will be given by A. Amorosi and Problems of Operation of Nuclear Power Plants will be discussed by R. L. Doan.

Water Technology will be well covered in several sessions. First one on Thursday will include Evaluation of Several Alkaline Compounds for Controlling Corrosion in Boiler Feedwater Systems by J. M. Decker and J. C. Marsh. Another paper will cover High Temperature Water for Process Heating Combined with Power Production by Paul L. Geiringer and Floyd Hasselriis.

Second session on Thursday afternoon will hear two papers on Demineralized Water for 1500 psi Steam Plants by C. R. Stewart and W. B. Gurney. Automatic Mixed-Bed Demineralizing at the Niagara Mohawk Power Co. will be described by Durando Miller and Expected Life of Anion Exchangers will be covered by Louis Wirth. A third Water Technology session on Friday morning will hear Water Problems in the Nuclear Power Field discussed by R. C. Ulmer, and Boilers and Boiler Waters by H. M. Rivers and S. R. Osborne.

The Fourth Water Session on Friday morning will hear papers on Silica Removal by Salt Splitting Without Demineralizing by S. B. Applebaum and B. W. Dickerson. Some Chemical Aspects of Hot Process-Hot Zeolite Plant Performance will be told by M. Lane and J. H. Duff.

Paul J. Grogan's* Graphical Solutions for Power Engineers

Feedwater Chemistry Relations

FEEDWATER CHEMISTRY relations are somewhat complicated by the many forms of analysis and expression in common use. Each of the methods has advantages in a given test situation, but it is often confusing to attempt further chemical calculations based on results of a given method of analysis. The accompanying chart has been prepared to bring about some correlation among the common methods of reporting chemical impurities soluble in feedwater, and also to present graphically many of the more common calculations.

Analysis and Expression

Methods of analysis and expression may be listed as follows: (1) Ionic; (2) parts per million; (3) grains per gallon; (4) equivalent parts per million as calcium carbonate; (5) equivalent grains per gallon as calcium carbonate, and (6) equivalent combining weights per million.

Most chemical compounds dissociate into positively and negatively charged particles when dissolved in water. Any chemical test for soluble impurities depends on the determination of the positive and negative parts, or *-ations* and *anions*, respectively. The compound $CaSO_4$, for example, dissociates into Ca^{++} and So_4^{--} when dissolved in water. Similarly, the compound $MgCO_3$ forms the two ions Mg^{++} and CO_3^{--}. When all these ions are present in solution, it is not possible to determine the original combinations with any known test. Procedures have been established whereby the concentration of various chemical compounds are synthesized on the basis of ionic concentrations and the solubility characteristics of each. It is generally sufficient, however, to leave such analyses in terms of the several common ions without regard to their respective origins.

Grains per Gallon vs PPM

Reporting concentrations in parts per million establishes a weight relation between the reported compound and the solution. It also permits accurate, convenient reporting of very low concentrations such as are found in feedwater (one ppm corresponds to 0.0001 per cent). While many still prefer reporting in grains per gallon, ppm expression is widely used and is gaining favor. In the interim of changeover, it is convenient to have a ready means of converting one set of units to the other without resorting to calculations.

Since there are about 8.33 lb of water per gallon and 1/7000 th lb per grain, a conversion factor of 17.1 ppm per grain per gallon can be derived for feedwater chemistry. This factor is 2 per cent high for 150 F water and 4 per cent high for 212 F water. To convert graphically from one unit to the other, project a line perpendicularly from the known data to the "conversion line" (see chart) and at right angles from the point of intersection to the other scale.

How to Use the Chart

Principal metallic ions found in feedwater have been listed across the top and bottom of the chart so that compounds of those specific ions may be found quickly by referring to the respective column.

To determine the concentration of a compound from a given concentration of the metallic ion, follow the procedure given here for checking calcium sulfate:

Example 1. A concentration of 20 parts per million of calcium ion (Ca^{++}) was detected in feedwater. Assuming enough sulfate ion (SO_4^{--}) to be present to combine with the available calcium ion, the resulting concentration of scale-forming calcium sulfate may be found by (1) entering the bottom scale of the chart at 20 ppm and projecting a vertical line to intersect the calcium ion (Ca^{++}) line, (2) drawing a line horizontally to the right to intersect the line representing calcium sulfate ($CaSO_4$), and (3) drawing a vertical line down to intersect the ppm scale at the bottom of the page. The point of intersection shows the potential concentration to be 68 ppm of $CaSO_4$.

It is possible also to use the chart in converting ppm of various compounds to their equivalent ppm as $CaCO_3$, or grains per gallon of compounds to equivalent grains per gallon of $CaCO_3$.

Example 2. To convert 60 ppm $MgSO_4$ to its equivalent concentration of $CaCO_3$, enter the bottom scale at 60 ppm and project a vertical line (A) to the $MgSO_4$ line. Construct a second line (B) horizontally to the left to intersect the "Equivalent PPM as $CaCO_3$" scale. The point of intersection shows the equivalent concentration to be 50 ppm as $CaCO_3$.

Example 3. To convert 6 grains per gallon $MgSO_4$ to an equivalent concentration of $CaCO_3$, enter the top scale at 6 grains per gallon and project a vertical line (D) down to intersect the $MgSO_4$ line. From this point, construct a horizontal line (E) to the right to intersect the "Equivalent Grains Per Gallon as $CaCO_3$" scale. The point of intersection shows the equivalent concentration to be 5 grains per gallon as $CaCO_3$.

Another application of the chart is in the determination of combining weights of different compounds to form new compounds. For example, $MgSO_4$ will combine with $Ca(OH)_2$ to form $Mg(OH)_2$ and $CaSO_4$, but a balanced reaction requires less $Ca(OH)_2$ than $MgSO_4$.

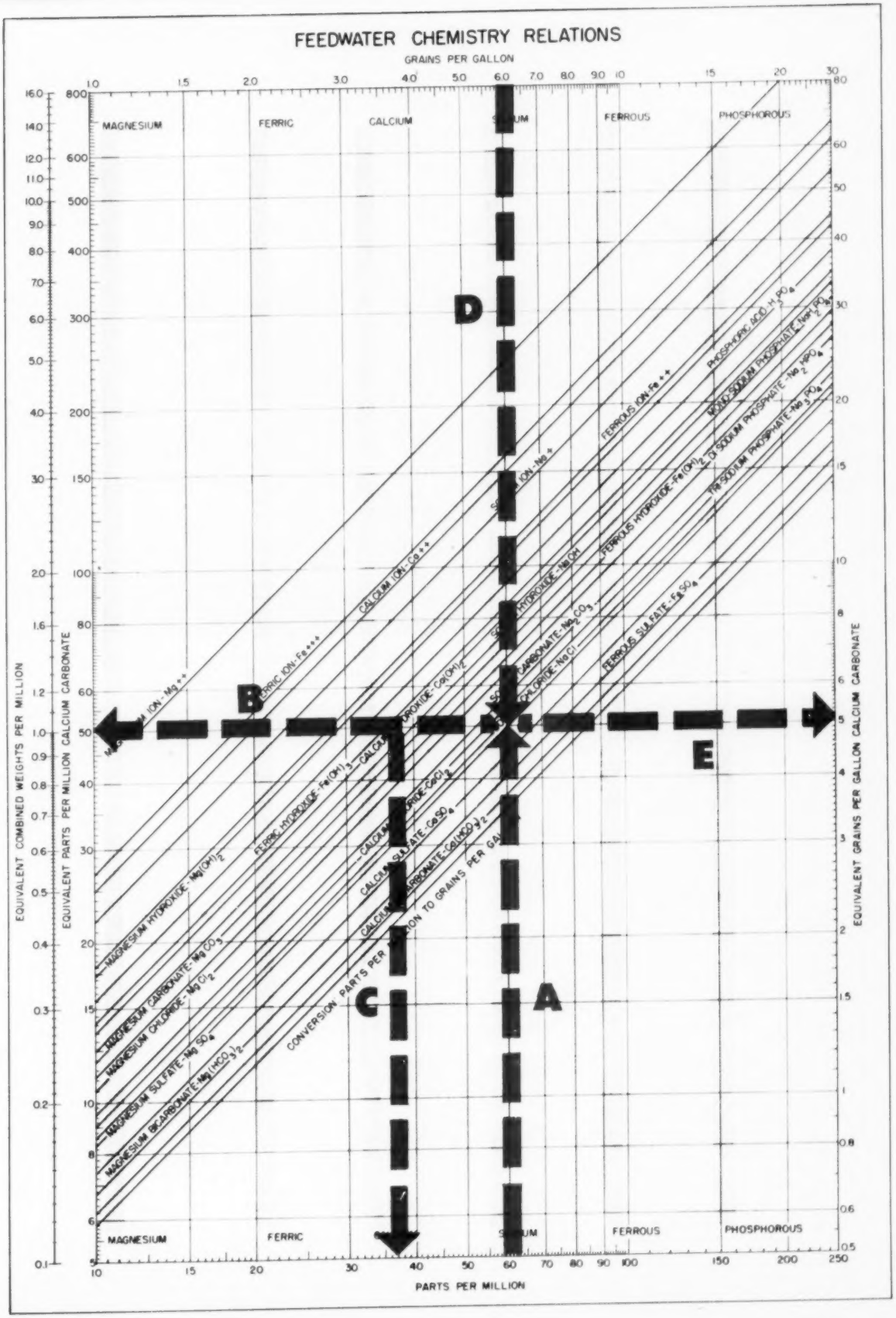
Example 4. To determine the combining weight of $Ca(OH)_2$ required to react with 60 ppm $MgSO_4$, retrace lines A and B (Example 2) and note the point of intersection of line B with the $Ca(OH)_2$ line. From this point, draw a line (C) downward to intersect the bottom horizontal scale. The point of intersection at 37 ppm represents the combining weight of $Ca(OH)_2$ with the 60 ppm $MgSO_4$.

Note: Combining weights can be calculated in grains per gallon or in parts per million, but it is necessary that the answer be obtained from the scale of entry and in the same units as the original data.

A vertical scale marked "Equivalent Combining Weights per Million" is located at the extreme left of the chart. When data is expressed in these units, it can be converted to the more common units by entering that scale with the value given and projecting a line to the right to intersect the given compound or ion. From the point of intersection, a vertical line to the bottom scale will intersect at the equivalent ppm concentration. Conversion to grains per gallon is accomplished with the "Conversion" line as previously explained.

While the accompanying chart is necessarily limited in size, the fact that all relations shown are directly proportional makes it possible to divide the data by 10 and multiply the answer by 10 to apply the chart to data far beyond the range of the scales. This should extend its application to all problems involving compounds or ions represented on the chart.

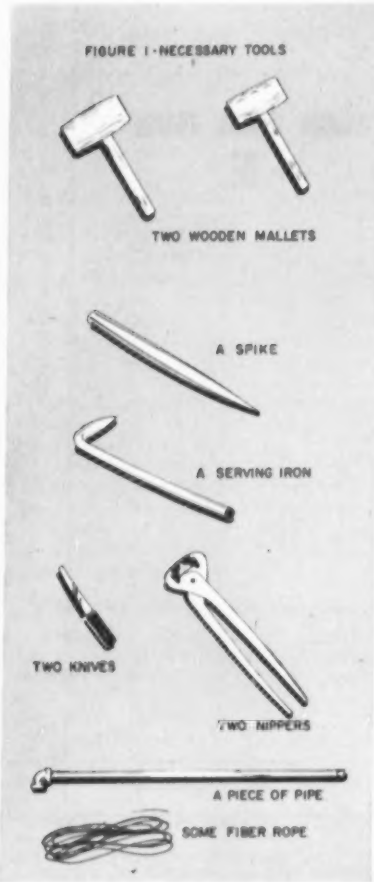
* Chairman, Department of Engineering, and Director of Engineering Institutes, University Extension Division, University of Wisconsin. All republication rights reserved by author.


FEEDWATER CHEMISTRY RELATIONS
GRAINS PER GALLON
MAGNESIUM
FERRIC
CALCIUM
FERROUS
PHOSPHOROUS
EQUIVALENT COMBINED WEIGHTS PER MILLION
EQUIVALENT PARTS PER MILLION CALCIUM CARBONATE
EQUIVALENT GRAINS PER GALLON CALCIUM CARBONATE
PARTS PER MILLION
A
B
C
D
E

How To SPLICE a Wire Rope Thimble

Wire rope thimbles can be spliced in many ways, but some of them distort the strands at the tucking points and reduce the strength of the splice. Here's a method of avoiding this danger

Fig. 1 (left) shows the tools you will need to carry out the splicing operations described in this article



TO ILLUSTRATE this method we will explain in detail how to make a thimble eye splice for a six-strand wire rope, fiber core or independent wire rope core, regular and lang lay. Regular lay means that the wires forming each strand of the rope are laid up in one direction and then the strands themselves are laid up in the opposite direction in order to make the rope. Lang lay means that the wires forming each strand and the completed strands are all laid up in the same direction to form the rope.

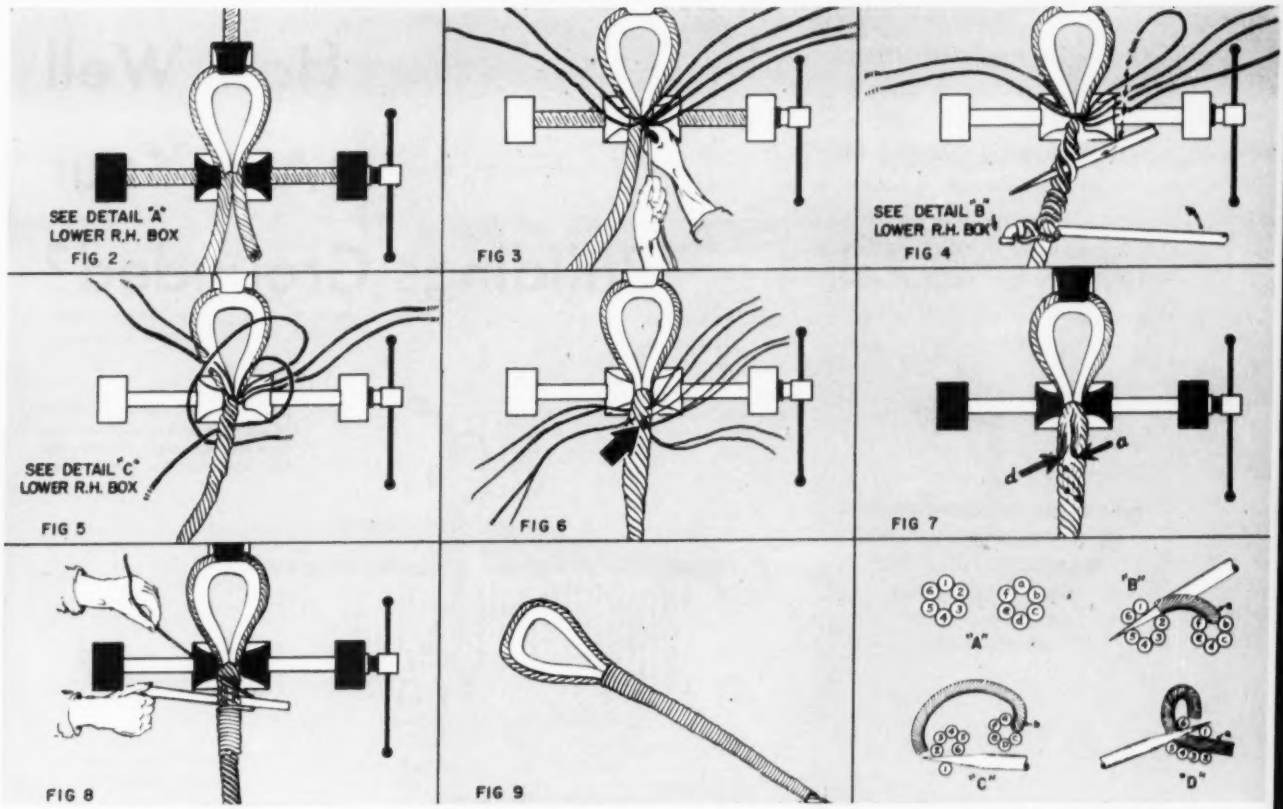
1. The tools are shown in Fig. 1 and consist of two wooden mailets, a spike, a serving iron, knife, nippers, a piece of pipe and some fiber rope.

2. Measure off two to four feet from the end of the rope, depending on the size of the rope, and bend it at that point. Lay the proper size thimble into the bend and clamp in a splicing vise, as illustrated in Fig. 2, with the loose end of the rope at the right when looking at the vise.

3. Unlay the rope back to the thimble, serve ends of strands with fine annealed wire, bend four strands to the right and two to the left and cut out the fiber core as shown in Fig. 3. A strand or independent wire rope core should be cut in the same manner as a fiber core except not quite so close to the thimble.

4. Untwist the lay of the rope somewhat by means of the fiber rope and pipe as shown in Fig. 4. Then drive the spike under the two top strands of the main part of the rope and insert the strand lying on top (i. e., under the point of the thimble) through the opening you have made. In Fig. 4, to make the illustration as clear as possible, the two top strands under which the spike is being driven are shown some distance from the point of the thimble. In practice the spike would naturally be driven under the two top strands as close to the thimble as possible in order to make sure the splice hugged the thimble tightly when made. The spike should be driven from right to left and the strand put through in the same direction. To make this clearer, a section of the rope and of the loose ends is shown in Fig. A. The strands in the main rope are numbered 1 to 6 and in the loose end *a* to *f* (Fig. A). The first step then, as stated, is to drive the spike in between 1 and 2 and out between 6 and 5 (Fig. B) and insert end *a* through this opening. Next pull the strand up tight and force it back by twisting the spike up along the lay toward the thimble.

5. Then tuck in the other ends thus: Follow strand 1 around to where it lies on the bottom of the rope (see Fig. 5) and drive the spike under it (i. e., between 1 and 6 and 1 and 2), from the right (Fig. C) and force end *b* through from the left, bringing it over the rope. Twist the spike back along the lay toward the



Figs. 2 to 9 (above) show stages in splicing operations described in text. Figs. A, B, C and D show cross sections through rope to make explanations clearer

thimble, after having pulled end up tight, until the strand can be worked up no farther. Next drive the spike from the right under 2 where it is at the bottom of the rope, force end *c* through from the left and work back as before; and so on, *d* under 3, *e* under 4, *f* under 5.

6. All the ends having thus been tucked whole once, they are tucked whole a second time. This second tucking consists merely of wrapping each end once around the same strand under which it was passed in the first tucking operation, and then forcing the tuck back as close to the thimble as possible. Thus *a* lies under 1 and 6 as a result of the first tuck just described (Fig. B).

Lift 6 by means of spike (Fig. D), bring *a* around and back under 6 and pull up tight. Strand *b* lies under 1 and is wrapped once around in the same way and so on for *c*, *d*, *e*, and *f*. Then strands *a* and *b* are given one more tuck each in exactly the same way as for the second tuck. When this operation is finished, strands *a* and *b* will have had three whole tucks each and strands *c*, *d*, *e*, and *f* two whole tucks each.

7. All the ends having been tucked whole as described, they are split; that is, by means of a knife the wires are separated into two parallel bundles for each strand, as shown in Fig. 6. *One* bundle from each end is then wrapped *three* times around the strand from under which it emerges, in a manner exactly the same as the second tucking of the whole end was done (see item 6). After this operation is finished, the splice appears as shown in Fig. 6.

8. Cut off the loose ends as close as possible except the two half strands *a* and *d* as shown in Fig. 7. These two strands should be cut off long enough to reach to the thimble after being opened up and hammered back. (See Fig. 8.)

9. Take a coil of seizing strand (see table for proper size), fasten one end loosely to the thimble, and cut off approximately the right length of wire required for the job. Then, using the serving iron as shown in Fig. 8, apply the serving. When up to the thimble, twist the ends together and cut off.

10. When completed the thimble splice will appear as in Fig. 9. If properly made and correctly used, there is no danger of it ever pulling out; and under excessive load such a splice would develop about 60 to 90 per cent of the ultimate strength of the rope, depending upon the size. The only reason it will not carry up to the full breaking strength is that the wires nick each other under heavy stress where the strands cross inside the tuck and are weakened slightly. The weakest part of the splice is in the vicinity of the last set of tucks and for this reason it is very important not to hammer, or distort this section any more than is absolutely necessary.

NOTE: If no seizing strand is to be used, all strands are given four instead of the three tucks mentioned under item 7. All ends are then cut short and the finished splice is hammered slightly.

SEIZING STRAND FOR THIMBLE SPLICES

(7-Wire Galvanized Seizing Strand)

Diam. of Rope	Diam. of Strand
¼ inch	1/16 inch
5/16 "	1/16 "
⅜ "	1/16 "
½ "	3/32 "
⅝ "	⅛ "
¾ "	⅛ "
⅞ "	5/32 "
1 "	5/32 "
1⅛ "	5/32 "
1¼ inch and larger	3/16 "

For the method described here we are indebted to John A. Roebling's Sons Corp., and for the photograph to The Detroit Edison Co.

For copies of this article write to the Editor, or use one of the prepaid post cards you will find elsewhere in this issue. Just write SPLICE on the card and mail it to us.

How Well Are Your Buildings Grounded?

Grounding equipment to a building structure is useless unless the structure itself is well grounded. Subject of ground resistance is complex, but enough is explained here in simple terms to enable you to test your system for safety and understand why you are doing it

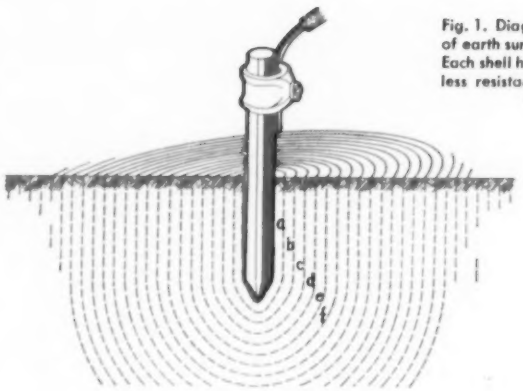


Fig. 1. Diagram showing thin shells of earth surrounding a ground rod. Each shell has larger diameter and less resistance than one it covers

FIRST OF ALL let us discuss the nature of a ground connection. Figure 1 shows an ordinary metal ground rod or electrode driven into the ground. Resistance to the flow of current through such a ground rod into the surrounding earth is made up of three component parts: 1. resistance offered by the rod itself, 2. contact resistance between the rod and the earth or soil surrounding it, and 3. resistance of the surrounding earth.

Rod Resistance Negligible

Rods, pipes, masses of metal, structures and other devices commonly used for ground connections are normally large enough to make their resistance a negligible part of the total resistance of the ground connection.

Contact between a ground rod and the surrounding earth offers much less resistance than one might suppose. In fact, if the rod is free from paint or grease, and if the earth is packed firmly around it, the Bureau of Standards has shown that the contact resistance is negligible. Rust on the surface of an iron rod has little or no effect in increasing contact resistance. Since rust is iron oxide, which is readily soaked with water and is of lower specific resistivity than most soils, it will usually interpose less resistance than an equal amount of earth.

A rod driven into ground of uniform resistivity will radiate current in all directions. Consider the rod in Fig. 1 and imagine it to be surrounded by very thin shells of earth, a, b, c, d, e, etc., so that one shell fits round the other as shown in the diagram. Naturally the first earth-shell surrounding the rod has the greatest resistance to current flow since it has the smallest cross section. Each succeeding shell has a larger surface area than the one over which it fits and so the resistance of each new shell is smaller than the one before it. The total resistance is increased every time we add a shell, but it increases more slowly the farther away from the rod we get. If we go on adding earth shells, we reach a point where the resistance of each new shell is so low that adding more shells will not appreciably increase the total resistance of the earth surrounding the rod.

This explanation shows that most of the resistance to earth of any ground rod will be found close to the rod. In fact, for driven pipes, about 90 per cent of the total resistance is generally encountered within the first 6 to 10 ft from the rod. This also applies to small pipes driven to a depth of not more than 5 ft.

If we plot on paper the resistance to earth of a grounded electrode against distance away from it, as shown in curve A of Fig. 2, we find that the resistance rises rapidly at first and then less and less rapidly, until finally it becomes practically constant. This is to be expected from

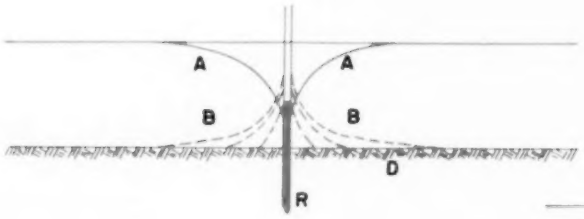


Fig. 2. (above) Volcano analogy to explain how ground resistance varies with distance from rod

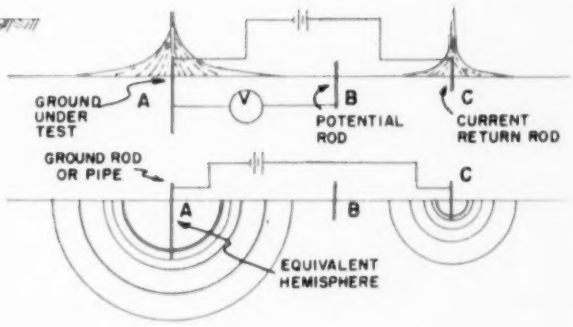


Fig. 3 (above) Diagram to show precautions needed for accurate ground resistance measurement

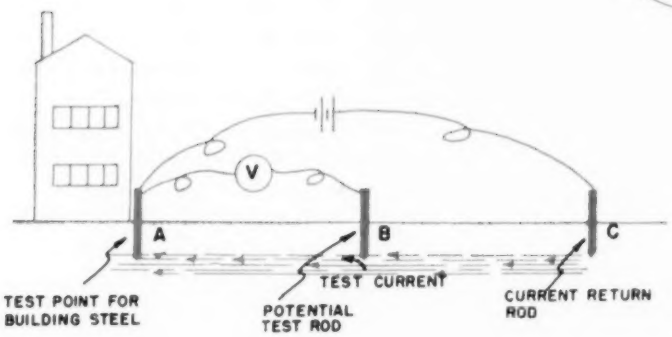


Fig. 4. (left) Diagram shows how building ground resistance measurements are taken in the field

the conception of ground connections just explained, as the addition of each successive shell of earth increases the resistance, but in smaller amounts each time because the resistance of each successive shell is less than the one before it.

Now, invert curve A, and observe it as curve B. The ground immediately surrounding the electrode is raised in potential (and resistance). The ground connection may thus be compared to a volcanic mountain rising out of a level plain. The descent is steep near the crater of the volcano, but slopes off more and more gradually until finally at a considerable distance away it joins the plain.

How Resistance is Measured

The ground resistance of the rod R must be measured from a point at least as far away as D in order to include all the resistance surrounding the rod. If the measuring point is farther away than D it would not matter, as the total resistance does not change much beyond point D; the important thing is that it is not measured from a point closer than D as then some of the resistance would be left out of the measurement.

Resistance between A and B (Fig. 3) is measured in practice by passing a known current between A and B and measuring the voltage drop produced by this current. Then by applying Ohm's law and dividing this volt drop by the current we get the resistance of ground connection A.

In practice the flow of current between A and B is obtained by driving rod C (called a current return rod) into the ground, passing a current between C and A, and measuring the volt drop between A and B.

This complication is necessary because we don't want to measure the ground resistance of the current return rod C but only the resistance of rod A. The current return rod — which is also surrounded by a field of resistance, or a number of earth shells — should be sufficiently far away from the ground under test so that the resistance fields of the two rods do not crowd each other. Applying the volcano analogy, as shown in Fig. 3, rod A is one volcano, the current return rod is another, and for accurate measurement they must be placed far enough apart so that the potential rod B may be placed on the level plain between them, as shown at B in Fig. 3. This rod B is just a point for measuring potential, and since it carries no current (or the negligible current taken by a voltmeter coil) its own ground resistance does not affect the circuit. If we were to use rod B as a current return point as well as a potential point, in other words if we dispensed with C and used B to circulate the current and also to measure the voltage, we would be measuring the resistance surrounding rod B as well as that surrounding A, and as we are trying to measure A's resistance alone the results would be inaccurate.

We have shown A as a simple rod, in order not to complicate the explanation, but in practice it could be a connection to building steel, as shown in Fig. 4, or a lightning rod, or a piping system, or any object to which equipment has been grounded. A good value of ground resistance for an industrial building should be less than 5 ohms.

Practical Resistance Measurement

Ground resistance in practice can be measured very simply with a Megger Ground Tester. The test rods are driven into the earth about 50 and 100 ft from the grounding point under test, the instrument is connected, the handle turned, and the resistance in ohms is read directly on the instrument scale.

The Tester supplies current from a self-contained d-c hand-driven generator, and after passing through the current coil of the ohmmeter, the current is changed into a-c for the test by means of a commutator or current reverser. The potential drop across the ground under test is picked up by the instrument and again converted into d-c for actuating the potential coil of the ohmmeter. The two coils of the ohmmeter are on the same shaft and work in opposition in the field of a permanent magnet. Thus the instrument is a true ohmmeter and indicates R as a ratio of E/I unaffected by the exact voltage in the armature or strength of the magnetic field.

How to Select the Right Fan

Factors you must consider to determine how a fan will meet the requirements of your system are given here. You must consider air quantity, density, pressure head, friction. Fan power will be discussed in another article

BY JOHN F. TOBIN *

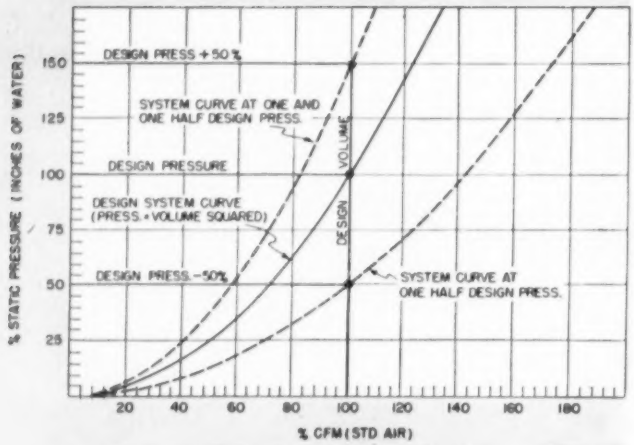

% STATIC PRESSURE (INCHES OF WATER)
DESIGN PRESS + 50 %
SYSTEM CURVE AT ONE AND ONE HALF DESIGN PRESS.
DESIGN PRESSURE
DESIGN SYSTEM CURVE (PRESS. × VOLUME SQUARED)
DESIGN PRESS. - 50%
SYSTEM CURVE AT ONE HALF DESIGN PRESS.
VOLUME
DESIGN
% CFM (STD AIR)

Fig. 1. This shows curves of air volume plotted against pressure for complete system, expressed in per cent, for standard air conditions

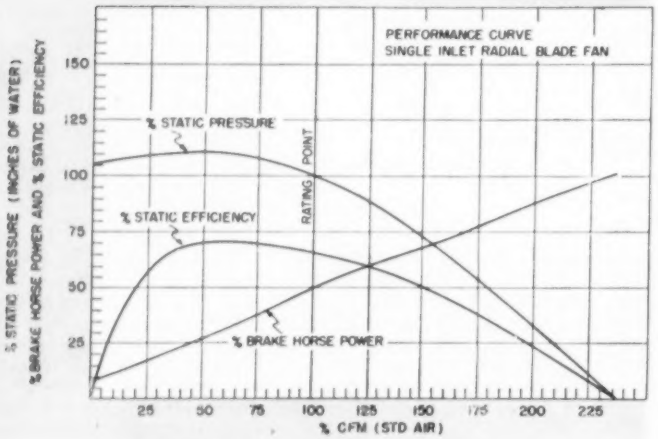

PERFORMANCE CURVE
SINGLE INLET RADIAL BLADE FAN
% STATIC PRESSURE (INCHES OF WATER)
% BRAKE HORSE POWER AND % STATIC EFFICIENCY
% STATIC PRESSURE
% STATIC EFFICIENCY
% BRAKE HORSE POWER
RATING POINT
% CFM (STD AIR)

Fig. 2. Typical fan curves show, in per cent, variations of pressures, efficiency and horsepower at constant speed and standard air

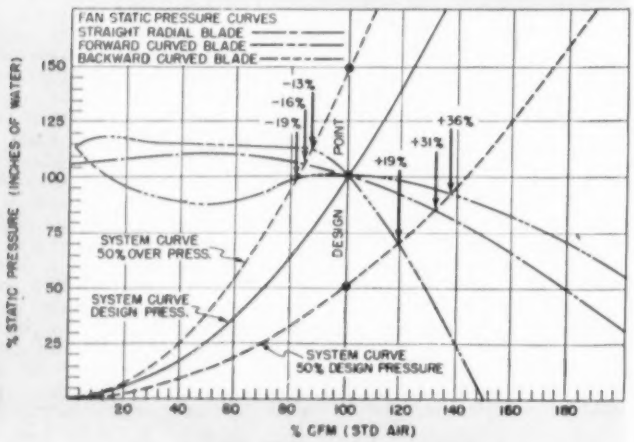


Fig. 3. Duct system curves and fan characteristic curves together, operating point at intersection, also effect of under- or over-estimate

FANS are purchased to transport a certain quantity of air from one point to another. The amount is generally fixed by the chemistry of combustion for boiler draft fans, by legal requirements or experience for ventilation, and by definite heat transfer coefficients for heating and air conditioning. The air quantity is expressed in cubic feet per minute, abbreviated "cfm."

All fan rating tables are based on the standard cfm, which is measured at sea level barometer of 29.92 in. Hg. and 70 F., dry, which is a volume of 13.33 cu ft per lb or a density of 0.075 for air or a volume of 12.82 cu ft per lb of a density of 0.078 for flue gas. Since the actual conditions are seldom standard, they should be specified, at least where different than standard, as all factors not specified otherwise will be considered as standard by the supplier in selecting the equipment.

Pressure Head

The third factor necessary for fan selection is the pressure head, usually expressed in inches of water in a vertical manometer gage, against which the air or gas is to be moved. We live in a deep sea of air which at standard conditions exerts a pressure of 14.7 lb psi and weighs 1.2 oz per cu ft. When in motion, air develops friction against stationary objects and has momentum requiring energy to start, stop or change direction. It is probably Nature's most powerful destructive force when in violent motion in tornados or hurricanes.

* Manager, Industrial Division
American Blower Corp., Chicago

CFM	Outlet Velocity	4½" S.P.		5" S.P.		5½" S.P.		6" S.P.	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
2700	1200	817	3.09	860	3.44	889	3.74	935	4.08
3150	1400	824	3.50	864	3.92	894	4.19	941	4.50
3600	1600	832	4.02	870	4.46	901	4.83	947	5.28
4050	1800	840	4.48	877	4.96	908	5.44	954	5.92
4500	2000	845	5.02	884	5.50	916	5.98	962	6.64
4950	2200	854	5.58	892	6.06	925	6.66	971	7.30
5400	2400	864	6.13	901	6.70	936	7.22	981	8.02
5850	2600	873	6.74	911	7.36	945	7.98	990	8.72
6300	2800	887	7.42	923	8.06	958	8.70	998	9.52
6750	3000	897	8.08	936	8.82	971	9.52	1009	10.34
7200	3200	911	8.85	947	9.68	982	10.34	1022	11.22
7650	3400	926	9.66	961	10.56	977	11.22	1045	12.14
8100	3600	939	10.56	976	11.46	1010	12.24	1050	13.20
8550	3800	954	11.50	990	12.38	1026	13.28	1060	14.18
9000	4000	970	12.38	1005	13.52	1041	14.32	1074	15.28
9450	4200	990	13.44	1021	14.40	1057	15.38	1088	16.45
9900	4400	1007	14.48	1039	15.54	1074	16.56	1106	17.68
10350	4600	1026	15.70	1057	16.69	1093	17.76	1122	18.88
10800	4800	1047	16.86	1077	18.02	1110	19.07	1140	20.16
11250	5000	1068	18.24	1097	19.34	1129	20.54	1156	21.68
11700	5200	1088	19.54	1117	20.78	1149	21.79	1174	23.07
12150	5400	1109	20.96	1137	22.26	1168	23.42	1195	24.72
12600	5600	1129	22.40	1159	23.84	1188	25.25	1213	26.48
13050	5800	1149	24.00	1180	25.52	1208	26.90	1233	28.16
13500	6000	1172	25.68	1204	27.28	1228	28.40	1255	29.98
13950	6200	1196	27.60	1228	29.20	1251	30.48	1276	32.16
14400	6400	1220	29.47	1245	31.22	1272	32.48	1299	34.00
14850	6600	1243	31.60	1272	33.20	1299	34.72	1319	36.16

Fig. 4. Showing portion of a typical fan performance table, giving speed and horsepower for different static pressures for a specific size and type of wheel. Fan manufacturers publish tables for their own fans

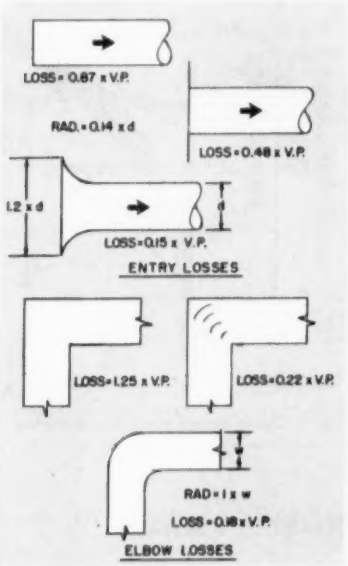

LOSS = 0.87 x V.P.
RAD. = 0.14 x d
LOSS = 0.48 x V.P.
L2 x d
d
LOSS = 0.15 x V.P.
ENTRY LOSSES
LOSS = 1.25 x V.P.
LOSS = 0.22 x V.P.
RAD = 1 x w
LOSS = 0.18 x V.P.
ELBOW LOSSES

Fig. 5. Diagram of various types of entries and elbows in fan systems, showing the losses

Air friction charts have been prepared from extensive test data for the usual air duct shapes. All reliable equipment manufacturers can furnish accurate air friction figures for their apparatus based on specified conditions, either as an average or as a maximum and minimum for apparatus subject to plugging with use such as air filters. Air friction at constant velocity varies directly with the density and all values should be corrected to actual operating conditions and totalled.

In fan work air is considered incompressible and subject to hydraulic formulas, such as $V = \sqrt{2gH}$ where V is velocity in ft per sec, g = acceleration of gravity or 32.2 ft per sec² and H = head of air in feet. This simplifies to $P = \left(\frac{V}{1096.2}\right)^2 \times d$ where P is pressure in inches of water, V is velocity in feet per minute and d is the actual weight of the air in pounds per cubic foot.

Air in Motion

To start air in motion a potential or static pressure SP equal to the velocity pressure VP is required plus an additional entry loss expressed in percentage of the VP depending on the type of entry, see Fig. 5. Once air is in motion it can not be changed in velocity without further loss of energy. The term velocity is used in its true meaning of a vector quantity; that is, speed and direction combined. Abrupt changes in direction usually result in 100 per cent loss of the VP present before the conversion. Good design of duct work will decrease this loss and many data are published on the proper design of the velocity change sections of a system. If impossible to follow established procedures, the estimated loss of a full VP at each velocity change is recommended.

The sum of the air friction figures and the velocity energy losses is the fan static pressure required to handle the quantity and type air specified through the designed system.

The volume and pressure values calculated for the complete system can be plotted, Fig. 1, which is a simple parabola curve through the design point, because the pressure varies as the square of the volume. Any reserve volume beyond the design point will require increased pressure as indicated on this curve.

Fan Performance Tables

Fan performance tables are published by most manufacturers for each size and type fan based on standard air, similar to the table, with columns of volume, speed and hp under each SP heading. Usually all the commercially practicable operating points are shown, and unless otherwise indicated ratings near the top of each column are the quietest and most efficient. However nothing is gained by using a fan with inlet and outlet larger than the ducts connected to it, because the velocity conversion losses may destroy the apparent gain. It is just as bad to use too large a fan as too small, because the noise and hp generally increase either way from the recommended selection point.

Fan performance tables are easier to use in the selection of fans than the characteristic curves from which they are prepared. Figure 2 is a typical fan characteristic curve obtained from laboratory tests and shows, at constant speed and standard air, the variation of pressures, efficiency and hp against volume from closed-off zero volume to maximum volume zero pressure.

Operating Point

When a fan is applied to a duct system, the only possible operating point is the intersection of the duct system curve and the fan characteristic curve, as shown in Fig. 3. The effect on the fan volume at constant speed due to under- or over-estimating the resistance by 50 per cent is shown by the dotted system curves.

The value of the shape of the fan characteristic curve to correct errors of selection is very limited. Always remember you are not buying a characteristic curve but a machine to punch air through a duct system.

The establishing of the true losses of the duct system is a more important requirement than the shape of the fan pressure characteristic curve.

If more air is needed from the same fan and system after installation, an increase in speed is necessary. If rugged fans are purchased initially the speed increase can be appreciable with corresponding increase in range of capacity.

In a future article, we will discuss the relation of these factors to fan power, which is also vital in selecting the right fan for the job. Other future articles on fans will cover the way in which fans must be controlled, also the fundamental laws of fans that will help you understand how they work as they do and how you can use them to best advantage.

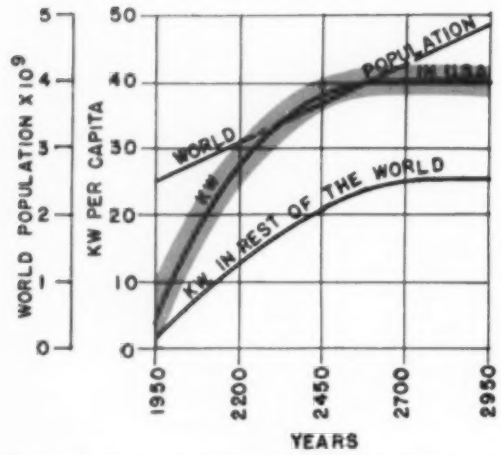


Fig. 1. Comparison of world population and electric power growth

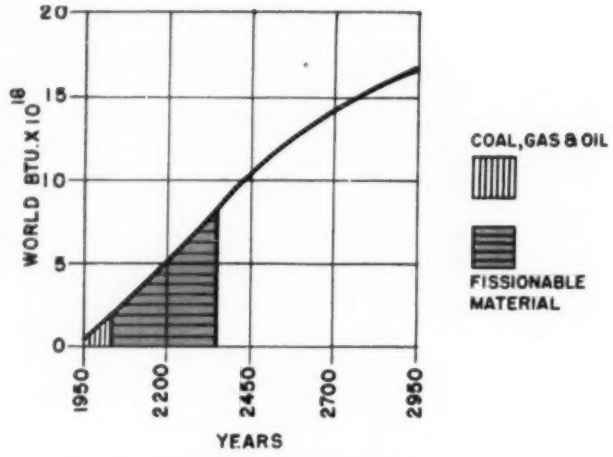


Fig. 2. Future use of world fossil and fissionable fuels

Despite our still ample coal, oil, and gas reserves, at the rate we are depleting them it behooves us to be thinking about the development of some new sources of energy, which will be so vital for our future

HARRY A. KULJIAN *

Takes

A Look at the World's Energy

POWER is so vital a part of our daily life that even a slight interruption in its supply virtually paralyzes our social and economic life. In primitive times man had only muscular energy to aid him in his work. Today, we have mechanical and electric power. Statistics show that the amount of capacity installed in the fixed and mobile power plants in the United States, totals over 800 million kilowatts. If we divide this by our population, it gives each person a little over 5 kilowatts.

All this power, whether generated in steam or hydroelectric plants, or developed in the internal combustion engines of our automobiles, tractors, locomotives or aircraft, stems from the sun. The earth's surface receives a tremendous amount of energy from the sun, most of which is radiated back into space. A small amount of it is absorbed by growing vegetable matter on land and in the sea. Some of it is used in evaporating water from the surface of the earth and in creating ocean currents. The energy temporarily stored in growing trees or in vegetation is converted into heat when combustion of wood takes place in a furnace or food is oxidized in human and animal organisms. Ultimately this heat is radiated back into space. The coal and oil in the earth represents the stored energy of sunlight laid down millions of years ago in the growth of animal and vegetable organisms. It can never be replaced and at present we are consuming these resources at an ever accelerating rate.

Hydroelectric Energy: — We now have nearly 20,000,000 kw installed in hydroelectric power plants. If we use all the available water of the country for hydroelectric generation, we may fulfill only 25 per cent of our requirements, and for the remainder, we are depending upon the energy stored up years ago as coal, oil and gas.

Steam-Electric Energy: — Recent studies indicate that if our electric consumption increases at the present rate, our coal will be used up in approximately 150 years. During the last 15 years, our engineers have developed more efficient ways of generating electricity by going into higher steam pressures and temperatures and introducing reheat cycles. We are now generating a kilowatt hour for less than 10,000 Btu, whereas only 10 to 15 years ago, we were generating a kilowatt-hour for close to 20,000 Btu, and 50 years ago, one kilowatt-hour took 90,000 Btu. Although the price of fuel and labor has increased continuously during the last ten years, the selling price of electricity, in general, has not increased.

Reason for this is that manufacturers are producing larger capacity boilers and turbines. Electric generating units up to 150,000 kw to 200,000 kw capacity are being supplied with steam from one boiler. At present, the efficiencies of some of these large boilers are being designed very close to 90 per cent. As far as boilers are concerned, any further gain in efficiency will not bring about material savings. On the turbine side, even with the reheat cycle, we are still losing 50 per cent of the available heat in steam in the circulating water of condensers.

Conversion of Food Into Energy in Living Bodies: — Efficiency of our heat engines depends upon the range of temperature through which they operate. The human or animal organisms convert the latent energy of food or fuel into work without any perceptible difference of temperature. It is remarkable to note how little food is consumed by a human being compared to the number of foot-pounds of energy it generates. Normally, a working person eats close to 3500 calories of food per day. If we had to burn this amount in a furnace to raise the temperature of water to make steam and use it in the usual manner to generate electric power, we would get, with 100 per cent efficiency, 10,750,000 ft-lb of energy. Yet, a working person can produce an average of 2,500,000 ft-lb of energy per day besides doing mental work, plus all energy given out as radiation and evaporation. Perhaps in this direction lies the development of a process. If we try to calculate the overall efficiency of the human body, by taking into account all useful external work done, the results are astonishing. It will indicate an average efficiency of 23 per cent, yet all this work is done at a very low temperature — below 100F; that is, at normal body temperature.

* President, The Kuljian Corporation

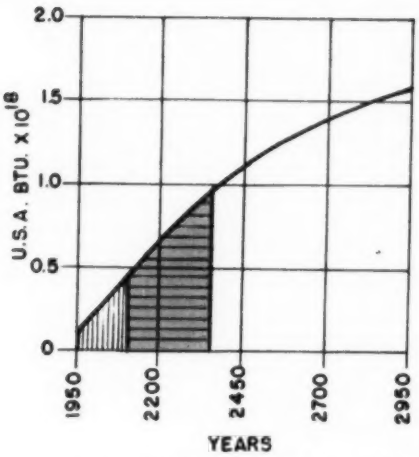


Fig. 3. Use of fossil and fissionable fuels in U. S.

Table I. Showing the potential energy resources of the world, both in total Btu and in the energy ratios

OIL AND GAS			
1. Crude oil	610×10^9 bbl	or	$3{,}500{,}000{,}000 \times 10^3$ Btu
2. Natural gasoline	11.5×10^9 bbl	or	$74{,}000{,}000 \times 10^3$ Btu
3. Shale oil	620×10^9 bbl	or	$4{,}000{,}000{,}000 \times 10^3$ Btu
4. Natural gas	$560{,}000 \times 10^9$ cu. ft	or	$600{,}000{,}000 \times 10^3$ Btu
Total, Items 1, 2, 3, 4			$8{,}174{,}000{,}000 \times 10^3$ Btu
COAL			
5. Coal left in earth's crust	3.482×10^{12} tons	or	$72{,}000{,}000{,}000 \times 10^3$ Btu
Total, Items 1 to 5 inc			$80{,}174{,}000{,}000 \times 10^3$ Btu
NUCLEAR FUEL			
Raw material	Uranium + Thorium		
6. Uranium	25,000,000 Tons	or	$1{,}700{,}000{,}000{,}000 \times 10^3$ Btu
7. Thorium	1,000,000 Tons	or	$71{,}000{,}000{,}000 \times 10^3$ Btu
Total, Items 6 + 7			$1{,}771{,}000{,}000{,}000 \times 10^3$ Btu
Ratio $\frac{(6+7)}{(1+2_1+3_1+4_1+5)}$	$\frac{1{,}771{,}000{,}000{,}000}{80{,}174{,}000{,}000} = 22.2$		
ENERGY UNDER EARTH'S CRUST			
Volume of Earth in cu ft	3.94×10^{22}		
Assume Earth's density	344 lb per cu ft		
Average temp	2150 F. Specific heat 0.25		
8. Total heat of Earth	$0.25 \times (3.94 \times 10^{22}) \times 344 \times 2160 =$		$7{,}360 \times 10^{21}$ Btu
Ratio $\frac{8}{(1 \text{ to } 7)}$	$= 7{,}360 \times 10^{21} = 1.851 \times 10^{21} = 4{,}000{,}000$		
SOLAR ENERGY			
Earth's surface receives from sun	300 Btu per sq ft per hr		
Land area exposed to sun	$\frac{1}{3} \times \frac{1}{2} \times 4\pi r^2 = 925 \times 10^{12}$ sq ft		
9. Total heat from sun on land areas	$300 \times 925 \times 10^{12} = 2775 \times 10^{14}$ Btu per hr		

Resources

Every single internal combustion engine, such as our automobile, every fuel burning apparatus and every boiler that is generating steam discharges carbon dioxide gas into the air. Every human being or animal that breathes, also discharges carbon dioxide gas into the atmosphere, and yet there is no noticeable increase of carbon dioxide gas in the atmosphere nor any reduction of oxygen.[1] At present, we are burning our fuel for power production at the rate of 750,000 tons per hour. This will discharge into the atmosphere every year, gases equivalent to a height of 24 ft, over the entire United States.

Nature's Separation of Oxygen and Carbon: — Nature cares for this condition wonderfully. It takes the carbon out of the carbon dioxide gas and feeds it to plant life and leaves the oxygen free in the atmosphere for us to use for the operation of internal combustion engines and boiler furnaces, as well as for human beings and animals to breathe to sustain our lives. If we had to separate the carbon from carbon dioxide in a mechanical or chemical way, we would have to use more energy to separate them than the energy we obtained by combining them; yet nature performs this effectively and easily. Therefore, it is fruitless for us to think of making fuels by decomposing the products of previous combustion, unless the energy to do so can be obtained.

Transmutation of the Elements: — In 1939, shortly before the beginning of the second world war, man realized his dream of splitting the atom. In that year experiments were made which showed that when a nucleus of an atom of uranium-235 captured a neutron, it suddenly split into approximately two equal parts, and at the same time, two or more neutrons were released. Of great significance was the fact that the mass of the resulting fragments of the atom was slightly less than the original mass of the uranium atom and the neutron.

This loss of mass is transformed into energy in accordance with Einstein's famous mass-energy equivalence equation $E = MC^2$ where E equals energy, M, the mass, and C, the velocity of light. Since the velocity of light is a very large number, it is obvious that only a small reduction in mass will produce a tremendous amount of energy. Indeed, when one pound of uranium-235 undergoes fission in this manner, the energy released is equivalent to that released in the combustion of some 1700 *tons* of good coal.

So far, nuclear energy has been used only in the explosions of atomic bombs but now we are beginning to use it for the production of electric power. Since the amount of energy in the uranium and thorium[2] resources of the world are vastly greater than that in our coal, oil, and gas reserves, our continually diminishing stores of these fuels is not going to retard our industrial civilization for some centuries to come.

A number of years ago, one of my high-school physics instructors was holding up a small test tube filled with water during a lecture. He stated that if all the 10 cc of water in the tube could be changed into helium gas, it would release more energy than all the people of New Haven, Conn. used in one day. At that time I doubted that he knew what he was talking about; but today that dream has virtually been realized. We have learned how to make a hydrogen bomb.

Energy trapped in the crust of the earth: — Another possible source of energy is the heat in the crust of the earth. The earth radiates more energy than it receives from the sun.[3] We know little concerning the origin of this heat but we know that as we go deeper into the earth the temperature rises. How this temperature gradient varies with depth we do not know but there are several places in the world where heat issues from the earth in the form of steam, usually in volcanic regions. Indeed at Larderello in Italy such steam wells have been harnessed to produce electric power. These wells are from 1600 to 2000 ft deep and superheated steam emerges at pressures of from 70 to 390 psi and at temperatures between 290 and

[1] Editor's Note: — Recent studies of observations made since 1866 indicate a slight but steady increase in the carbon dioxide content of the earth's atmosphere, perhaps 5 per cent.

[2] Editor's Note: — Thorium is not fissionable but, by the capture of a neutron, thorium-232 is converted into uranium 233, which like uranium 235 is a fissionable material.

[3] Editor's Note: — Per unit of area, however, the amount of heat emerging from the earth is very small, several thousand times less than the average heat per unit area reaching the earth from the sun.

Table II. Data on the various relations of the world's population and energy, 1950 to 2450, showing energy available in United States and in rest of world

Years	a USA Population $\times 10^9$	b Rest Population $\times 10^9$	c World's Population $\times 10^9$	d USA KW per Capita	e USA KWH $\times 10^{12}$	f Rest KW per Capita	g Rest KWH $\times 10^{12}$	$h = e + g$ World KWH $\times 10^{12}$	j USA BTU $\times 10^{15}$	k Rest BTU $\times 10^{15}$	$l = j + k$ World's BTU $\times 10^{15}$
1950	0.150	2.288	2.438	5	6.55	0.5	10.00	16.55	0.098	0.150	0.248
2000	.157	2.403	2.560	10	13.75	3.5	73.50	87.25	.206	1.103	1.309
2050	.165	2.515	2.680	15	31.70	5.75	126.00	147.70	.325	1.890	2.215
2100	.172	2.730	2.802	20	40.10	8.00	191.00	221.10	.465	2.865	3.330
2150	.180	2.756	2.936	25	49.60	10.00	241.00	280.50	0.591	3.615	4.206
2250	0.195	2.978	3.173	31.5	64.70	14.00	364.00	417.70	.806	5.460	6.266
2350	.210	3.206	3.416	35	65.50	17.5	491.00	555.50	.965	7.365	8.330
2450	.225	3.434	3.659	37.5	74.70	20.5	615.00	688.70	1.105	9.205	10.310
2550	.240	3.662	3.902	39	83.00	22.5	720.00	802.00	1.230	10.800	12.030
2650	0.255	3.890	4.145	39.7	88.50	24.0	817.00	905.50	1.330	12.255	13.585
2750	.270	4.118	4.388	40	94.50	25.0	900.00	994.50	1.420	13.500	14.920
2850	.285	4.345	4.631	40	100.00	25.0	950.00	1050.00	1.500	14.250	15.750
2950	.300	4.574	4.874	40	105.00	25.0	1000.00	1105.00	1.575	15.000	16.575

$e = a \times d \times 8760$ = Population $\times$ kw per person $\times$ 8760
$= (0.210 \times 10^9) \times 35 \times 8760 = 64.4 \times 10^{12} \times 15{,}000$ (Btu per kw)

$j = e \times 15{,}000$ (Btu per kw)

400 F. At present the installations there total 254,000 kw. Even before the drilling of new wells for the current expansion of generating capacity the steam production ran to 4,400,000 lb per hr from 140 wells.

Assuming that the interior of the earth has an average temperature of 2160 F, then, as shown by the accompanying table of the Potential Resources of the World, the total amount of heat under the Earth's crust is $7{,}360 \times 10^{24}$ Btu or 4 million times as much as all the coal, oil, gas and fissionable material.

Whether man will ever be able to utilize large amounts of the earth's heat remains to be proved but the energy is there if we can only get hold of it. Radiation measurements indicate that the amount of energy in the earth's crust is millions of times greater than that stored in all the coal, oil, gas, and fissionable material on earth.

How Long Will Our Fuel Reserves Last? — Although the coal and oil deposits in the earth were laid down millions of years ago it is only within the last century that we have begun to use these fuels at an accelerating rate.

The estimated heat energy in the world's coal reserves is conservatively placed at 72,000,000,000,000,000,000 Btu.

The estimated heat energy in the oil and gas reserves similarly are placed at 8.2 billion, billion Btu.

The estimated heat energy in the fissionable material of the world is roughly 1770 billion, billion Btu or 22 times as much as the heat value of the coal and oil together.

If the population of the world increases to double the present figure during the next thousand years, and the United States power consumption per capita increases eight times its present value, and the rest of the world's power consumption increases to 60 per cent of that of the U. S., then all our resources of coal, gas, oil, and fissionable material will be used up in about 400 years.[4] See Fig. 1.

Four hundred years is a very short time in the history of mankind and if we are to live and progress on this earth we will have to find some other source of energy, one which is plentiful and reliable.

Solar Energy: — The only unfailing source of energy that we can look forward to in the future is that which we receive from the sun. This is everlasting; all life on the earth's surface is sustained because of this energy. The abundance and the continuous nature of this source of energy make it most suitable for the power requirements of this progressing world. Every day the earth's surface receives from the sun 8.325 billion-billion Btu, which is as much heat as there is in all the oil and gas in the whole world. The oil and gas reserves total 8.2 billion-billion Btu. In just 10 days we receive as much heat from the sun as there is in all the coal, oil and gas in the world. In 220 days we receive as much heat as there is in all the fossil fuels and the fissionable material in the world.

An earnest investigation for the economical and effective use of this fabulous power is not only worthwhile but one of our duties towards future generations. If some method can be found whereby we may tap this inexhaustible source of energy, mankind will have solved its power problems for all time.

It is to the sun that we owe the existence of all our coal, oil, and gas reserves in the world. While these fossil fuels are still plentiful as far as present needs are concerned, at the accelerated rate at which we are converting them into power, they will be practically exhausted in a little over a hundred years. There are many reasons why we should take immediate steps to conserve these fossil fuels.

Coal, oil, and gas are too valuable to burn under boilers for the production of steam and electricity. Coal and gas can be liquified, and liquid fuels constitute the sole source of power for aircraft, automobiles, tractors and farm machinery. We can generate electricity in large utility and industrial power plants by the use of fissionable material but we cannot use such material to power automotive equipment or small industrial plants. It is possible that atomic power plants will be developed for military aircraft but it is unlikely that such power will be used in aircraft generally.

Recently the U. S. Atomic Energy Commission awarded contracts to a group of utilities to build two coal-fired power plants, each having a million kilowatts capacity to furnish power to gaseous diffusion plants. It would have been better if these plants had been designed to use fissionable material as fuel rather than coal. Construction costs might have been somewhat higher but it would have conserved coal without which some day our small industries cannot survive.

We must, therefore, start to develop ways of using fissionable material as soon as we can to preserve our coal, oil, and gas. Then we must develop methods of using solar energy or the heat in the earth's crust so as to preserve remaining stores of fissionable material for the maintenance of peace in the world.

Editor's Note: — The importance of the subject which Mr. Kuljian discusses in this article cannot be overemphasized and it is heartening to see that it is receiving increased attention throughout the world. The economy of the free world depends upon abundant supplies of low-cost energy and unless we can develop new sources to replace those we are depleting so rapidly our future technological development will be gravely affected. It is of interest to know that the U. S. Atomic Energy Commission is interested in this subject to the extent that recently it delegated Palmer Cosslet Putnam to make a detailed study of our energy resources. The results of this study, which was an extremely comprehensive one, were published recently in a book entitled Energy in the Future. This book is now available from D. Van Nostrand Company, Inc.

[4] Editor's Note: — The author's estimate of population increase are far on the conservative side. An analysis of six separate studies of world population indicate that by the year 2000 — just 46 years from now — the world population will be 3.9 billion, and that by 2050, it will reach a value of around 6 billion, 2.6 times what it is today.

PRACTICAL ENGINEER and ELECTRICIAN SECTION

CONTENTS . . . Page 99 . . . Background for Gage Glass • Lube Oil Tank Gets New Dress • Check Air Pressure Before Plugging In Tools • Page 100 . . . Figuring Neutral Currents in 3-Phase Circuits • Page 101 . . . Simple Stroboscope • Tighten Blind Bolts • Manhole Cover Lifter • Battery Explodes • Page 102 . . . QUESTIONS AND ANSWERS . . . Calculate Flow Through Funnel? Prevent Pulverizer Explosion? Water Hammer In Tail-Pipe? Patch Underground Oil Storage Tank? Heat Loss From Cypress Water Tanks? Prevent Corrosion In This Steel Stack?

Lube Oil Tank Gets A New Dress

By D. L. COCHRANE

OUR LUBE OIL tank and normal accessories were an eyesore and led to oil contamination and general poor housekeeping. We had to clean the oil measures each time they were used to avoid lubricating with the dust which settled on their oily surfaces, and the top of the tank stayed in a more-or-less oily and dust-catching condition.

Finally we got enough of this and, starting with the tank shown in Fig. 1, cleaned up and repainted the tank and built a cabinet for the oil cans and measures as shown in Fig. 2. The cabinet was made of plywood and pressedwood, fitted with standard cabinet latch and hinges, and painted to match the tank. A maroon paint dressed up the assembly.

Little effort was required to clean up our messy situation, and the materials expenditure was extremely low. Take a look at your own lube storage facilities and see if they can't be improved in a similar manner.

Fig. 1. Before repainting, the lube storage tank looked like a promising candidate for scrap heap

Fig. 2. After housing accessories in cabinet and painting the assembly, maintenance is simplified

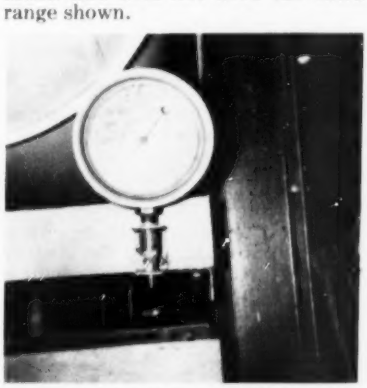
Check Air Pressure Carefully Before Plugging In Tools

By D. L. COCHRANE

OUR HOUSE AIR system comes from a 350-psi starting system for the plant diesels. Pressure is reduced by an adjustable regulator, but this occasionally gets fouled and does not regulate as it should.

To avoid accidents resulting from plugging air-operated tools into a supply which may have unsafe pressures, we have appropriated a pressure gage and make it a practice to plug the air hose into the gage fitting first. If the pressure is safe, we plug in the air tool.

The gage is portable and can be carried to any of our many compressed air outlets. The gage in the illustration is from a "retired" installation and does not need the extra range shown.



Gage can be mounted on your tool cart so that it will always be handy, thus encouraging its usage

Try Making This Background For Your Gage Glass

National Safety Council

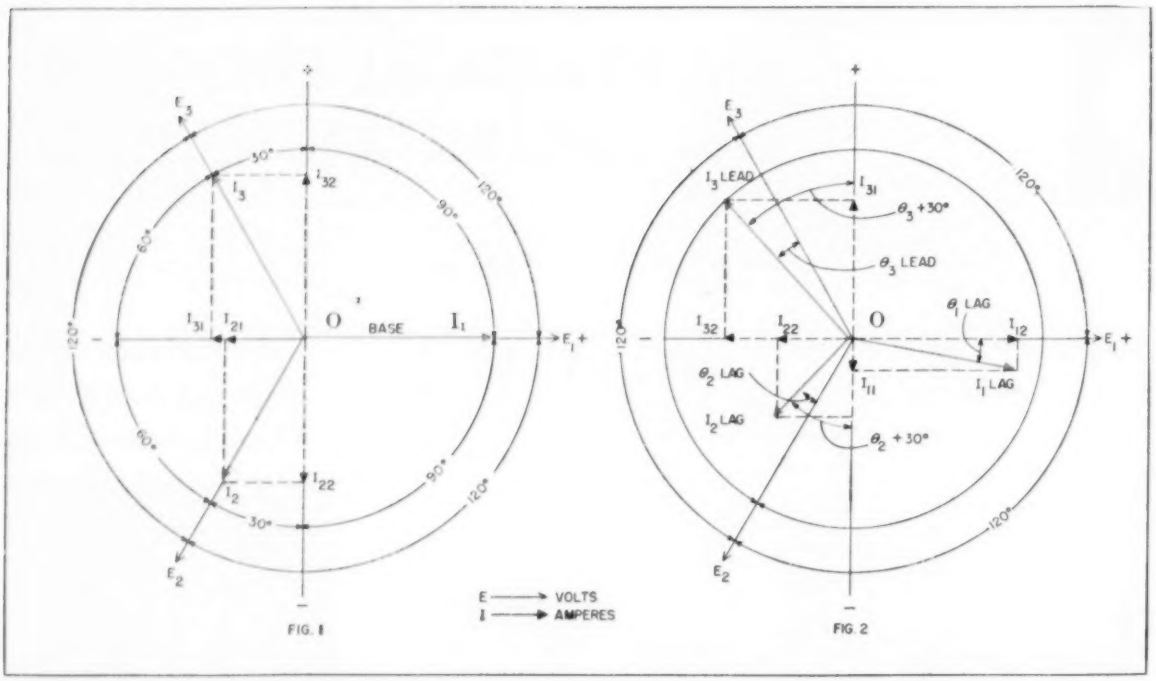
Background for water gage glass shows upright through empty glass, inverted through water

TRY THIS TRICK on a water column. It will increase your accuracy and speed in reading water levels, and it costs nothing to operate.

Cut a piece of asbestos pipe to the length of your water gage glass, then split it down the center. Mark off a piece of heavy paper in alternate light and dark stripes (yellow and black should work well) at 45 deg to the horizontal, and line one half of the asbestos pipe. A cold water paste will hold the paper in place. Mount the assembly behind the gage glass with metal brackets, locating the pipe so that the glass will be flush with the split face of the pipe.

When light is reflected through the empty part of the glass, the pattern will appear upright and slightly distorted. When the pattern is reflected through the water-filled portion of the glass, however, it will be inverted and will show a sharper outline than appears through the empty glass. This is shown by the illustration.

It may be necessary to rearrange your lighting so that the pattern will not be in shadow.



Figs. 1 & 2. Vector diagrams of voltages and currents, 3-phase 4-wire system. Fig. 1: Equal currents at unity p.f. Fig. 2: Unequal currents, power factor

Figuring Neutral Currents in 3-Phase 4-Wire Systems

Graphical methods of finding neutral current are not always quicker than calculation. Here is an accurate way to figure these currents

By C. O. VON DANNENBERG

YOU may want to find the neutral current in an unbalanced three-phase system. In view of the widespread use of this type of circuit, it seems strange not to find in general use a method of determining the neutral current quickly and accurately. Here is such a method.

Figure 1 shows a three-phase four-wire circuit operating at 100 per cent power factor for each circuit. The line to neutral voltages are OE_1, OE_2 and OE_3 with currents I_1, I_2, and I_3 respectively. These currents may be balanced or unbalanced. For this diagram we are using E_1 as the base, though any of the others could be used just as well.

Beginning with Fig. 1, we can set up a system of plus (+) and minus (−) coordinate axes as indicated and project on these the horizontal and vertical components of the different line currents. These will be plus (+) I_1 and minus (−) I_{31} and I_{21} for the horizontal axis and plus (+) I_{32} and minus (−) I_{22} for the vertical axis. From elementary trigonometry these values are: (+) I_1 for the base and (−) I_{21}, (−) I_{31} for the horizontal axis which for the latter two are: I_2 sin 30 and I_3 sin 30. Similarly, for the vertical axis we have (−) I_{32} equal to I_3 cos 30 and (+) I_{22} equal to I_2 cos 30. I_1, it is clear, has no component or projection on the vertical axis. We can now set up these formulas:

(1) Neutral Amps (p.f. = 1.00)

$$= \sqrt{[I_1 - \text{Sin } 30\ (I_2 + I_3)]^2 + [\text{Cos } 30\ (I_3 - I_2)]^2}$$

which by substituting the values of the sine and cosine becomes

(2) Neutral Amps

$$= \sqrt{[I_1 - 0.5\ (I_2 + I_3)]^2 + [0.866\ (I_3 - I_2)]^2}$$

For a completely balanced circuit at Power Factor 1.00, the neutral current is zero. If the power factor is 1.00 and the currents are different, the same formula (2) can be used, substituting the values of current as estimated or as given. Actually the method takes longer to describe than to put into actual application.

The method can be applied just as well when the current values differ for each circuit and in addition we may have three different power factors which may be leading or lagging. Fig. 2 shows conditions when I_1 and I_2 are lagging, I_3 leading, and they all have different values. The formula (2) is then merely modified by making voltage vector E_1 the base and applying the angles of lead or lag from the actual circuit data given. We can then write equation 3 shown at the bottom of this page.

Equation (3) indicates the complication and difficulty of drawing angles obtained from tables. In the description given for (3) if I_3 had been leading, the angle between the vertical axis and I_3 would have been $(30 - \theta_3)$ and correspondingly for I_2; if it had been lagging the angle would have been $(30 - \theta_2)$. If I_1 had been leading, I_1 sin θ_1 would have been plus.

It should be noted that formula (3) becomes the same as formulas (1) and (2) when the angles θ_1, θ_2 and θ_3 become zero.

(3) Neutral Amp =

$$\sqrt{[I_1 \text{Cos}\,\theta_1 - I_2 \text{Sin}\,(\theta_2 + 30) - I_3 \text{Sin}\,(\theta_3 + 30)]^2 + [I_3 \text{Cos}\,(\theta_3 + 30) - I_1 \text{Sin}\,\theta_1 - I_2 \text{Cos}\,(\theta_2 + 30)]^2}$$

Make and Use This Simple Stroboscope

By L. W. FITZPATRICK *

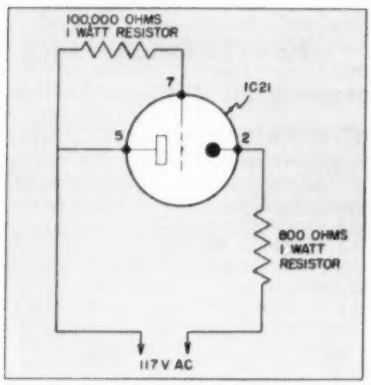
SLOW MOTION pictures of operating equipment are easily obtained with this simple and inexpensive device which you can make yourself. It takes a cold cathode 1C21 tube, a 100,000-ohm, 1-watt resistor and an 800-ohm, 1-watt resistor, all of which will cost about $3.00.

All you need to know to build this unit is shown on the accompanying wiring diagram. It can be mounted any way you wish, using materials available in your shop. A cardboard tube could be used, in which case the home-made stroboscope would resemble a flashlight.

Short, accurately timed flashes will be emitted by the cold cathode tube in synchronism with line frequency. When the flash is equal to or very near the speed of an object under observation, the motion of that object is visually arrested or seems to move very slowly since the human eye retains images about 1/20 of a second. The same would be true if the speed of the object is greater than line frequency by a whole multiplier; for example, a spot on the end of a shaft which rotates at 7200 rpm would appear stationary because every other time it passes a fixed position it will be lighted by the tube flashing 3600 times per minute.

Shining the tube on gears, cams, drills, saws, or cutting tools, for example, will show misalignment, noise sources or vibration either stationary or in slow motion. Motor slippage, belt slip, clearance between moving objects, the effect of flywheel mass on speed variation, etc., can readily be seen. Of course, rotor motion in generators can be viewed as if stopped, and power and torque angles can be checked by observing rotor displacement as load is applied.

* Chief Engineer, Department of Corrections, State of Missouri, Jefferson City, Missouri.



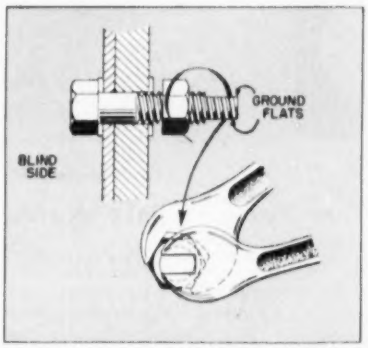
Wiring diagram for the home-made stroboscope. It operates on 110–120 volts and at line frequency

Flats on Threads Tighten Blind Bolts

By LESTER RILEY

WHEN IT IS necessary to tighten bolts where one end is inaccessible, here is a trick which helps.

Use bolts which have about one inch of extra thread, but grind flats on opposite sides of the threads at the end. Be careful in grinding down the threads so that it is still possible to spin on the nut. Push the bolt through the hole from the blind side so that the threaded end is accessible. Place the plate or other work to be bolted over the protruding threaded end and spin on the nut while holding the bolt against turning. When the bolt is spun finger-tight, set one wrench on the ground flats and a second wrench on the nut.



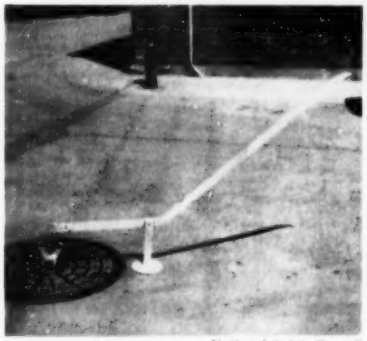
Flats ground on opposite sides of the threaded section serve as gripping surface for second wrench when tightening a bolt with an inaccessible head

Manhole Cover Lifter

MANHOLE COVERS are notorious back-strainers and finger-mashers, but this device made from scrap can prevent such injuries. A lever, made of ¼-in. steel, is pivoted about 4 ft from the handle. The pickup end of the lever should be equal to the manhole cover radius plus about 6 in.

A pair of flat-nosed blacksmith's tongs can be cut off near the hinge to form the pickup. Two cold shuts link the pickup with the lever. A 6-in. disk is the footing for the fulcrum pedestal.

Hooks are bent into the flat noses of the tongs at about 90 deg to the flat so that they close under the hand grip in the cover when it is raised. The heavier the cover, the tighter will be the grip. Despite the obvious desirability and simplicity of such a device, strong backs still dominate this phase of materials handling.



National Safety Council

This simple device lifts and swings clear any manhole cover with a center hand grip without strain

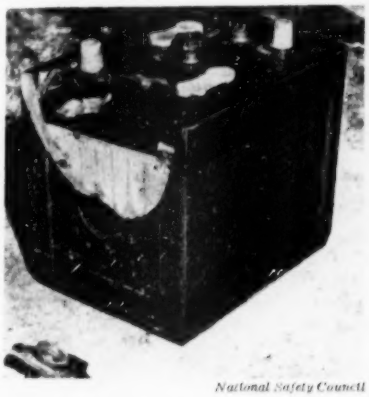
Hydrogen Ignites—Battery Explodes

A STORAGE battery had been on charge for some time and an operator stopped by to check the electrolyte level. It was rather dark, so the operator used a cigarette lighter to provide light for the inspection; just once, of course.

As soon as the flame was brought over the opening in the cell, hydrogen gas, generated by the charging operation, exploded. The explosion ruptured the battery case and splashed acid over the face and eyes of the operator. Fortunately, a water hose was being used nearby so that the acid could be flushed from his eyes immediately. Blindness would probably have resulted if this had been delayed.

The moral of the story is:

Checking batteries on charge (or otherwise) with an open flame for light is not habit-forming. If you insist on doing this, take along a medic and a water hose for subsequent cleaning up.



National Safety Council

This harmless-looking battery nearly blinded an operator when he checked water with his lighter

QUESTIONS AND ANSWERS

Question No. 521

Can You Calculate Water Flow Through Funnel?

IN YEARS gone by I have often had occasion to use a funnel receiver for overflows from weigh-tanks and for cooling water discharge from heat exchangers. In every case, however, I always had to make a rough guess as to the size of the funnel and tailpipe required and then correct the installation as dictated by experience. This is obviously wasteful, and it is also a little irritating to be so defeated by a blamed funnel.

Can any of your readers tell me how to *calculate* the proper size of the funnel and tailpipe? I will settle for the calculation for water only, but would prefer something equally applicable to liquids of varying viscosities.

G. P.

Question No. 522

How Prevent Pulverizer Explosion?

IN VIEW of the occurrence of explosions in one of our coal pulverizers and associated filter shakers, we are extremely interested in installing safety devices to forestall future mishaps.

A device, if one exists, that we are interested in is one that will detect a dangerous coal-air mixture within the coal-air passages. Perhaps you may suggest such a device or refer me to articles that deal with coal-air explosion prevention devices or suggested safety precautions.

Any assistance you can give me will be greatly appreciated.

New York E. W. D.

Answer to No. 511

What Causes Water Hammer In This Tail-Pipe?

Slope Pipe, Restrict Outlet Says Horner

I SUGGEST that E. E. M. take the following steps in order:

1. Install valve in tail-pipe near bottom. Regulate valve to maintain 1 atmosphere about 34 ft below condenser discharge.

2. Starting at the condenser discharge, remodel piping to give the following arrangement:

a. 16 x 14-in. 90 deg reducing elbow.

b. Length of horizontal 14-in. pipe.

c. 14-in. 90 deg elbow (not a tee).

d. Vertical leg installed with valve near bottom as mentioned above.

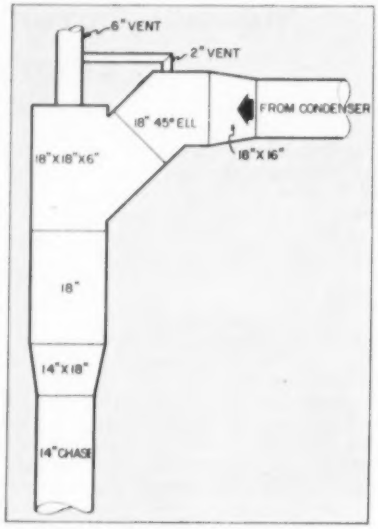
If possible, install horizontal 14-in. pipe with a slight slope (high end toward condenser) to avoid vapor pockets.

Kosmosdale, Ky. R. B. HORNER

All A Matter of Velocity—Beard

ALL OF THE alterations that have been made, and which you propose could be made, are things which should have been included in the original construction had the job been more thoroughly engineered originally. My sketch suggests what I think should be done in addition to what has already been done to make the job more correct hydraulically. The theory behind this sketch is as follows:

Water moving from the condenser through the 16-in. pipe loses velocity as it enters the 18-in. ell. From here it again gains velocity, due to the downward slope into the chase, but not nearly as abruptly as is occurring in the present set-up. This is due to the fact that the bend now is a right angle and the pipe is reduced instead of enlarged at this point. Reduction of velocity of the fluid at this point will permit much more satisfactory air and vapor separation.



Beard's modification to decrease velocity changes

If this set-up still does not completely solve the problem then it may be necessary to add some form of restriction down below to maintain a column of water in the chase pipe, thereby further reducing velocity and turbulence in the pipe.

I feel confident that these suggestions will eliminate the water hammer problem and will be very much interested in learning of the results of any additional effort which E. E. M. may make in this direction.

Lancaster, Pa. ROBERT C. BEARD

Offset Critical Pressure Drop With Water Injection—Hess

APPARENTLY Mr. E. E. M.'s water hammer difficulties are caused by cavitation at the tee where the water changes direction 90 degrees.

Very low pressures can be obtained below the inside curve in a case like this with only moderate water velocities. Pressures in the neighborhood of 29 in. Hg may occur.

At the point of such pressure reduction, dissolved gases and vapor will expand to form fairly large bubbles which may break off and be trapped and entrained in the falling water column. At the pressures existing in the tail-pipe, they probably would not completely collapse until they encounter a point of much higher pressure. This would be at the base elbow where the water again changes direction and bears against the outside curve of the elbow.

A simple and very inexpensive remedy for this condition would be to drill and tap the tee at a point immediately below the lower inside curve of the tee and bring into it a ½-in. water line from any convenient source; for example, the condensing water line.

The admission of water to this point will raise the pressure high enough so that cavitation cannot occur. If no bubbles are formed at this point, no implosion will occur at the base elbow; hence, no water hammer.

Oklahoma City, Okla. J. L. HESS

Answer to No. 517

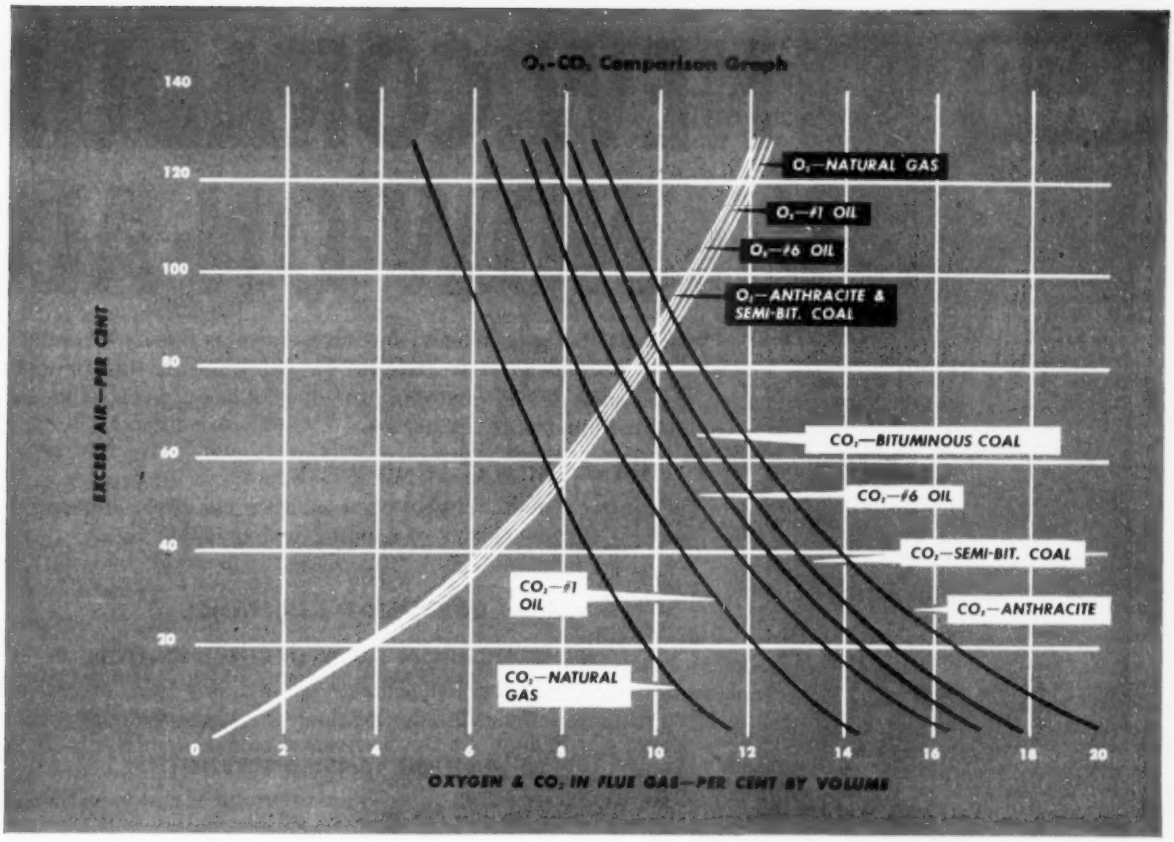
How To Patch Underground Oil Storage Tank?

Bolt Down Gasket and Metal Patch—Riley

REMOVE the area of tank in which the leak exists. Leave only good solid metal or you may have trouble again in a short time.

To remove the bad area, drill a series of holes and use a saw or chisel, but do not use a grinder because of the fire hazard. After the hole has been made and the section removed, remove the dirt from outside the tank to an area about 6 in. larger than the hole on all sides.

Make and form a patch of plate the same *continued on page 108*



HOW TO BURN Multiple Fuels EFFICIENTLY

When switching from one fuel to another or burning more than one fuel at the same time, you can realize large savings with a continuous indication of Oxygen content in your flue gas—because Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

This fact is borne out by the graph showing the relationship of excess air to CO_2 and O_2 in the flue gas of five common fuels. While the O_2 curves nearly coincide (especially in the important 30% excess air range) the CO_2 curves diverge widely.

Large savings possible

This deviation was costing a medium sized refinery in Michigan $35-40 per day in boiler room fuel costs. Burning a combination of oil and gas they found that a combustion control system to handle their multiple fuel firing conditions would cost more than their small boilers.

With the purchase of a Hays Magno-Therm Oxygen Recorder, they found that they were able to reduce fuel costs enough *to pay for the instrument in 40 days.*

Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

If you are facing the problem of multiple fuel combustion, you will want a detailed copy of this O_2-CO_2 Comparison Graph as well as Hays Bulletin 52-829-56 — describing the Magno-Therm Oxygen Recorder. Write for this free information.

With the Hays Magno-Therm Oxygen Recorder you get:

- *Continuous, highly accurate indication and recording.*
- *Complete compensation for temperature and pressure effects.*
- *Freedom from chemicals or hazardous fuel burning in the analyzing process.*
- *Swift, sure electronic operation.*

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 7, INDIANA

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ACCO products

NEW CORADUR NOW ON ALL

"CORADUR" is good news for valve buyers. Created specifically to provide a better material for valve stems, this important new R-P&C metallurgical development gives valve users these important advantages:

1 • DURABILITY—LONG WEAR

Careful control of metallurgical components gives physical properties, such as low coefficient of friction, which reduce wear, prolong stem life.

2 • HIGH CORROSION RESISTANCE

3 • FREEDOM FROM DEZINCIFICATION

Chemical composition protects against this form of corrosion often experienced under brackish or adverse water conditions.

4 • HIGH TENSILE STRENGTH

Over 95,000 psi—25% more than ASTM or Federal specifications.

How Quality Control Protects R-P&C's Complete Valve Line

• At R-P&C a rigorous quality control program governs every step of the manufacturing operation—insures that each R-P&C valve conforms precisely to the close tolerances established for it. Precision inspection techniques check manufacturing operations and verify material soundness to insure that the trouble-free operation and long life engineered into each R-P&C design are delivered to the valve buyer.

Modern technological developments verify exactness of manufacturing operations. All bronze, iron and steel castings for R-P&C valves are made in the R-P&C foundry under careful metallurgical controls. Radiographic techniques using radium or radioactive isotopes, verify casting soundness.

A variety of gauging methods, including some developed by R-P&C engineers, verifies dimensional accuracy of all valve parts.

Performance of each individual valve is verified by hydrostatic and other tests before it leaves the factory. These tests are normally conducted at pressures in excess of those for which the valve is rated.

ASBESTOS-PACKED COCKS, an R-P&C exclusive, are furnished in iron in sizes from ¼" to 6" with screwed or flanged ends.

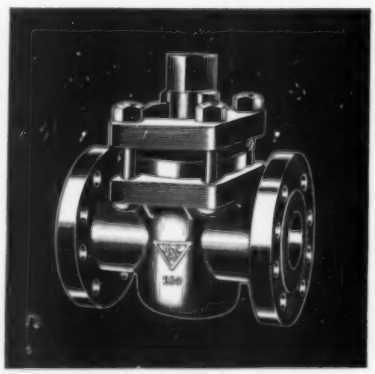
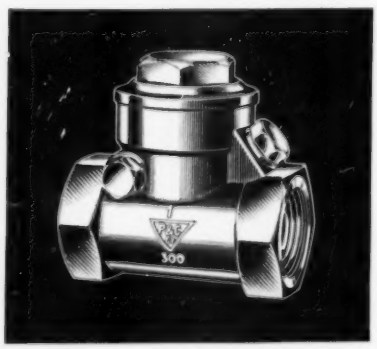


FIG. 212 SCREWED END BRONZE CHECK VALVE typifies R-P&C's complete check valve line—furnished in iron, bronze or cast steel in sizes ranging from ¼" to 24".



For more data circle 547 on Post Card

STEMS
R-P&C BRONZE VALVES

• Stems for all R-P&C bronze globe, angle and gate valves are now machined from cold drawn, stress relieved rods of this new aluminum-silicon bronze alloy. For example, at the left is a CORADUR stem on a **Fig. 706** rising stem gate valve, which is typical of R-P&C's complete bronze valve line. Rated for 200 pounds at 500° F, this valve is provided in sizes from ¼" to 3". Each of these valves is hydrostatically tested at a pressure of 600 pounds before leaving the factory.

Fig. 706, like all valves in R-P&C's complete line, is packed with construction features which reduce maintenance and insure long life. For example:

Nickel Alloy Wedges

Slip-on type has perfect symmetry of faces, making wedges reversible. Milled grooves on sides engage guide ribs in body, reducing wear on seats.

Wedges are entirely removed from line of flow when valve is fully opened. This reduces vibration thus eliminating a principal cause of valve wear.

Seats, integral with body, are made of ample width, to provide high wear resistance.

Packing • Valve design removes packing from high temperature zone, prolonging life. Positive backseat permits repacking under pressure when valve is full open. Formed rings of lubricated and graphited braided asbestos facilitate repacking, prolong packing life.

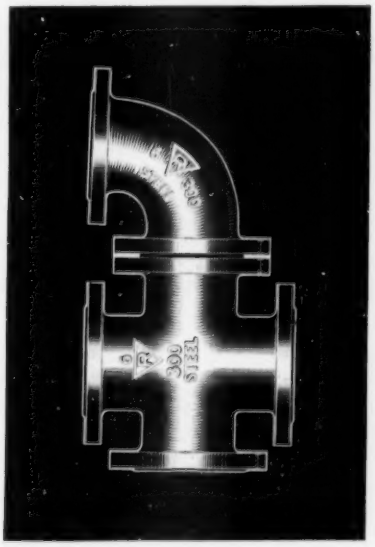
Union bonnet construction gives added strength to the valve and permits repeated removal of the bonnet without danger of distorting body or threads.

• • •

There is a valve to meet your every bronze valve requirement in R-P&C's complete line. Write today for your copy of catalog to R-P&C Valve Division, American Chain & Cable Company, Reading, Pa.

BAR STOCK VALVES are precision machined from highest quality bronze, carbon steel, or alloy steel bar stock. Working pressures range from 10,000 lbs. at 150°F to 475 lbs. at 1,000° F. Sizes from ⅛" to 1".

PRESSURE SEALED BONNET JOINT CAST STEEL VALVES are furnished in gate and globe valve styles in 900 lb., 1500 lb., and 2500 lb. pressure classes.



CAST STEEL FITTINGS, ells, tees, laterals, crossers, reducers—screwed or flanged ends. Furnished in sizes up to 24", in pressure classes from 150 lbs. to 2500 lbs.

See the complete R-P&C *line at your distributors or write for catalog to* R-P&C *Valve Division, Reading, Pennsylvania*

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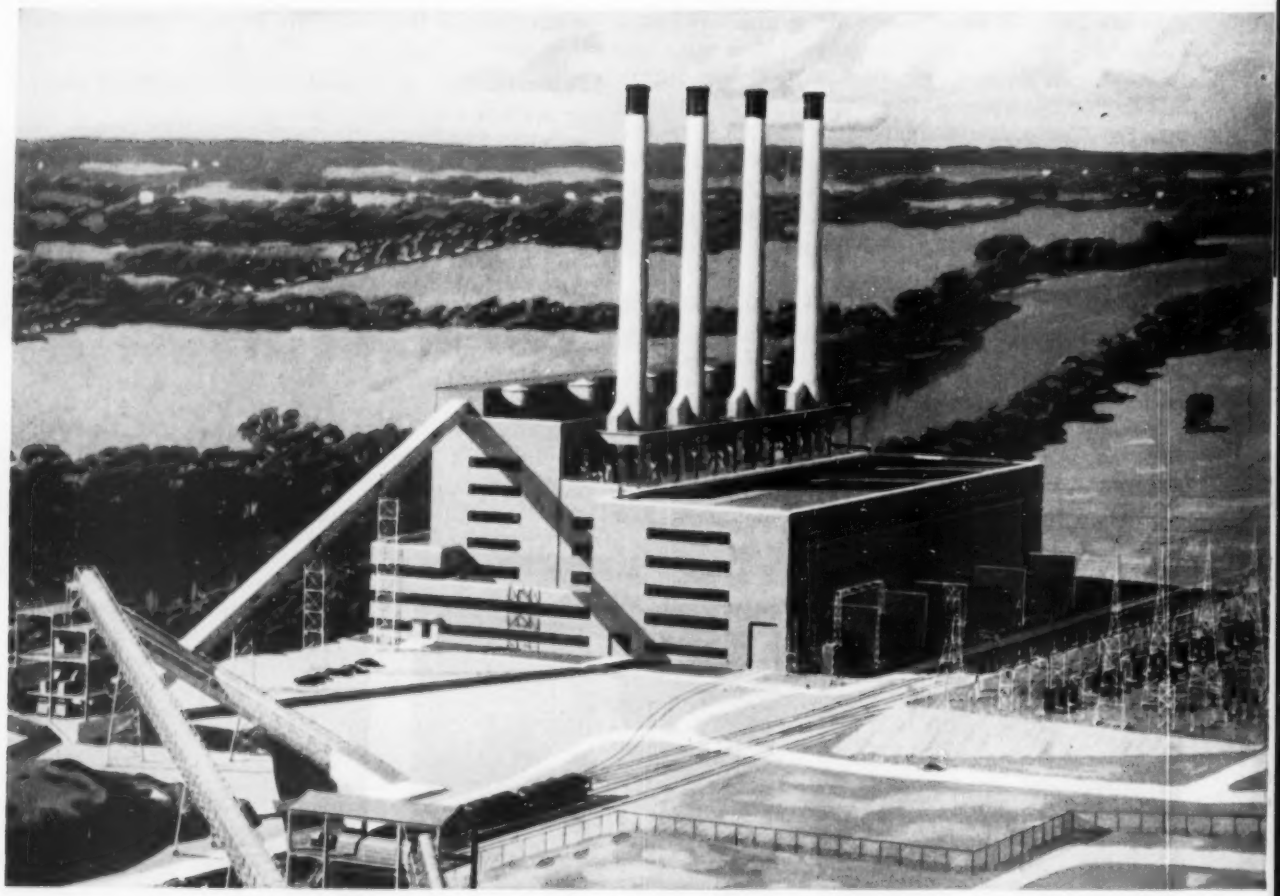
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

New Wabash River Station of Public Will Boost System's



NEW WABASH RIVER STATION, West Terre Haute, Ind., of the Public Service Company of Indiana, Inc., designed by Sargent & Lundy, Inc., consulting engineers, will have four Foster Wheeler reheat-type steam generators with the following capacity:

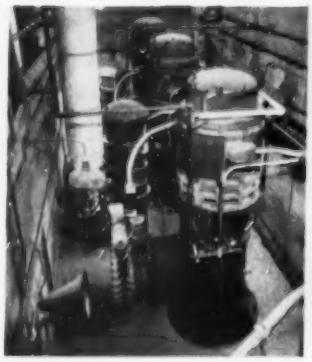
Maximum continuous capacity

Primary steam flow	700,000 lb per hr
Reheat steam flow	624,000 lb per hr

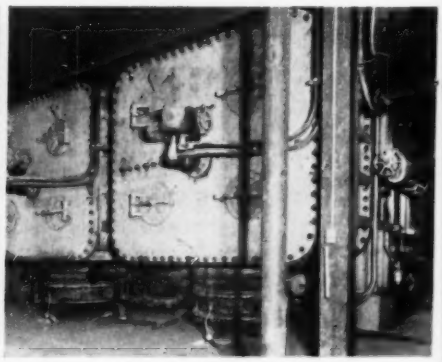
Operating pressure

Superheater outlet	1500 psig
Reheater outlet	401 psig
Final steam temperature	1005 F
Final reheat temperature	1005 F
Feed water temperature	451 F

Coal pulverized by Foster Wheeler ball mills, two for each steam generator.



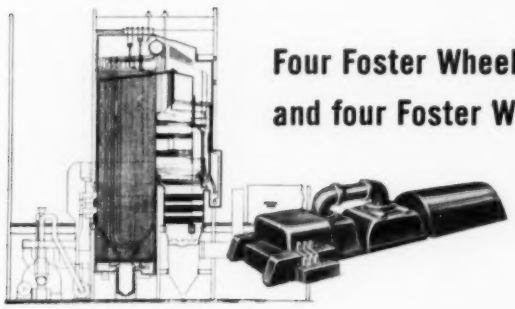
Foster Wheeler vertical circulating pumps, two of which provide a total of 62,000 gallons per minute of cooling water to each condenser.



One of four "double-flow" Foster Wheeler condensers, of the 70,000 sq ft rectangular, two-pass design.

Service Company of Indiana, Inc.
Output Capability to 940,000 kw

...*with four reheat cycle steam generators!*



Four Foster Wheeler 700,000 lb/hr reheat steam generators and four Foster Wheeler 70,000 sq ft "double-flow" condensers will serve turbines each with a gross generator output of 100,000 kw.

Designed to operate on the reheat cycle, the four Foster Wheeler steam generators at the new Wabash River Station of the Public Service Company of Indiana, Inc. will have an aggregate capacity of 2,800,000 lb steam per hr.

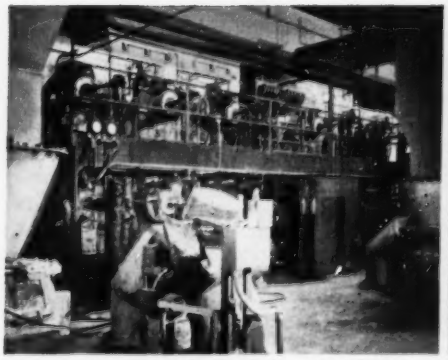
The use of combination radiant and convection superheaters makes possible precision control of final steam temperature over a wide load range. Since superheating is done partly in the radiant section, the gas temperature leaving the furnace can be sufficiently reduced so that, even with the Indiana coal used, complete freedom from furnace slagging is assured.

An all-convection reheater is located deep in the low-gas-temperature zone beyond the convection superheater section. Here safe metal temperatures are maintained during starting, shutting down and under emergency operating conditions. Reheater final steam temperature is controlled by regulation of by-pass dampers located at the economizer outlet.

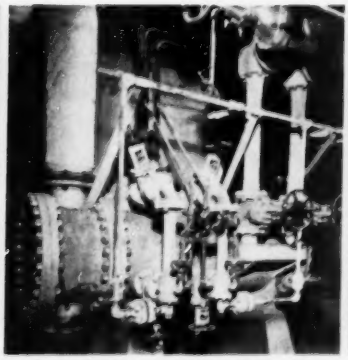
Outstanding features of the "double flow" type condenser are its inherent deaerating action and its complete utilization of available headroom. Also incorporated is a special provision for reversing the circulating water flow, thereby providing a desired cleaning action of condenser tubes.

FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

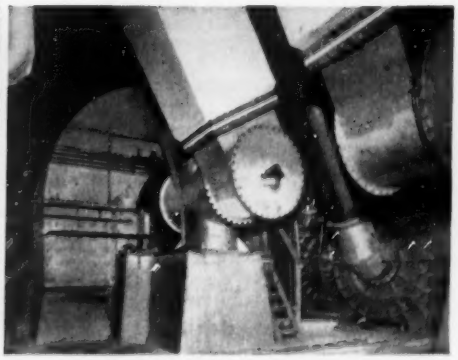
FOSTER WHEELER



Firing aisle of one of the reheat boilers shortly after initial start-up.



Twin-element two-stage steam-jet air-ejector, with combined surface inter- and after-condensers, maintains vacuum in each 70,000 sq ft condenser.



Exhausters and ball mill pulverizers located on basement level.

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La Cabrera Power Plant
MARACAY, VENEZUELA

Designed and Engineered by

The **Kuljian** *Corporation*

Engineers and Builders of over 70 power plants in all parts of the world—also steel mills, oil refineries, chemical plants, breweries, textile plants and airports.

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Questions and Answers

continued from page 102

weight as the tank and make it conform to the curvature.

Drill holes in its perimeter about 2 in. from its edge and not over 4 in. apart. You should plan on using a bolt no smaller than ½-in. and about 3 in. long. Locate, drill and tap the bolt holes in the tank. Make a substantial gasket to place between the patch and the tank.

Reach through the hole and screw the bolts from outside the tank. Place gasket and patch over the bolts inside the tank and run down the nuts.

Here is where we use that extra length on the 3-in. bolts. Before screwing the bolts in place, grind the threaded end flat on two sides so that the threaded end can be held by a wrench. With the nuts run down finger-tight, hold the bolts with one wrench on the ground flats and tighten the nuts with a second wrench.

Threads in the holes through the tank plate serve only to hold the bolts in place until the gasket, patch and nuts have been put in place.

Twin Lakes, Minn. LESTER RILEY

Used Steel Patch and Neoprene Gasket for Five Years—Ortner

I WOULD SUGGEST that N. J. have a sheet of metal rolled to the contour of the tank, of sufficient thickness and large enough to cover beyond the point of corrosion. With the metal extending to solid material, holes should be drilled and tapped in the tank. He should then obtain a sheet of neoprene gasket material (or any other oil- and acid-resistant material) and place this inside the tank. By using a good grade of sealing cement on both sides of the gasket and bolting the plate to the inside of the tank, N. J. should have no further trouble with leakage. We have used a similar patch and it has served well for the last five years. I would suggest that if there is danger of explosive fumes that an air drill be used.

Moorhead, Minn.

HENRY C. ORTNER

Don't Patch, Replace—Broadhead

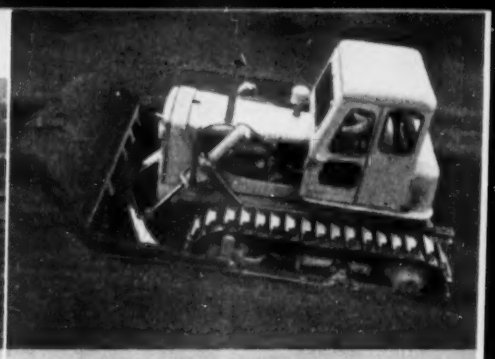
CAVITATION can and does occur on the outside as well as the inside of a tank, the rapidity depending on the acidity of the oil in the tank, of the soil surrounding the tank, and on the combination of oil and soil.

To attempt to patch the tank would not only be expensive but would, no doubt, develop into a regular job at varying intervals and spots. It is the writer's opinion that it would be wise to install another tank, perhaps a larger one, above ground and located where it could be filled easily and piped to the building where it is used.

A tank *continued on page 111*

Stockpiles coal anywhere —
Coal brought in by water to Midwest chemical plant is economically hauled to stockpile, spread in 4-in. layers and compacted by Allis-Chalmers 41,000-lb., 175-net engine hp. HD-20 Tractor pulling scraper that carries 18 tons.

Stockpiles, compacts, loads —
Allis-Chalmers 40-drawbar HD-5G Tractor Shovel pushes coal onto stockpile, then with its 16,200 lb. plus added weight of loaded bucket compacts it, and finally with 2-yd. (1½-ton) bucket loads coal from stockpile to trucks for hauling to plant as needed.



Handles coke for steel mill —
Allis-Chalmers 72-drawbar hp., 18,800-lb. HD-9 Tractor dozes coke out onto stockpile, levels and compacts it, then reclaims it as needed. Freezing of coke surface in winter no longer hinders operation with tractors as it did with previous system.

Takes care of all coal handling . . .
This 109-drawbar hp., 27,850-lb. Allis-Chalmers HD-15 Tractor easily stores and reclaims all coal for an Eastern power plant.

Tractors Make Coal Handling More Flexible

Storing and reclaiming coal with tractors is considerably more flexible, as well as more economical, than with complex conveyor or crane systems. Tractor handling permits keeping equipment investment in close balance with current operating needs at all times. As demand increases, or if it is necessary to speed up handling during rush periods, more tractor units can be added. Also, storage areas can be abandoned without leaving money tied up in idle stationary equipment.

With tractors, coal can be stored wherever there is available space — and can be reclaimed whenever needed. Crawler tractors work free of rails and runways, make their own "roadway" anywhere. They can handle all coal moving — or will supplement existing facilities.

Work with Blades, Scrapers, Front-End Shovels

When unloading station is near storage area, tractors with bulldozer blades can economically move coal alone or work along with other equipment. Teamed up with scrapers, the tractors can haul coal to remote storage areas located anywhere. Tractor shovels are versatile units that can move coal to stockpiles and reclaim it, maintain piles, or load it to hoppers, cars or trucks.

Whether they work with blades, scrapers or front-end shovels, tractors spread coal out in thin layers and compact it well by constant travel over the pile. This tight packing of horizontal layers eliminates flues that cause spontaneous combustion in loose conical piles.

Handle Other Jobs, Too

Tractors offer additional versatility and flexibility through other than coal handling use. They also can take care of plant or yard maintenance, car spotting, snow removal, excavating, moving heavy equipment or materials, dozens of other jobs.

Find out more about how tractor equipment can improve coal handling for you. See your Allis-Chalmers industrial tractor dealer for a demonstration. Also, send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors."

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Scovill's outstanding Technical Application Services frequently give recommendations that make *all* the difference in the way a tough installation pays out. The potential savings are well worth looking into. Ask us to prove it. Scovill Manufacturing Company, 99 Mill Street, Waterbury 20, Connecticut Phone Waterbury 4-1171.

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Questions and Answers

continued from page 108

so installed would permit gravity feed to the place of consumption, would facilitate proper care and maintenance, and would not necessarily create a hazard. After completing the new installation, the old tank could be drained and abandoned with hardly any effect on production.

Oneonta, N. Y. A. P. BROADHEAD

Use Neoprene, Steel Patch or Grout Liner, Says Burns

THERE ARE several ways in which N. J. can repair his oil storage tank without welding. In all instances it is understood that the vessel must be purged and made safe to enter.

If the leaks are small, the corroded areas can be cleaned by wire brushing or, if feasible, sandblasting; then a coating of neoprene is applied. This material, which is available in liquid form, should be sprayed and then painted on in successive layers until a thickness of about 1/16-in. is obtained. Proper precautions should be taken to see that surfaces are primed and that ventilation is supplied during spraying and brush coating operations.

If the corroded area is fairly large, but localized, a steel plate and neoprene gasket can be used. The gasket should be thick enough to compress and form a tight joint. Likewise, the steel plate should be rigid (the thickness depending on its size) so that there will be a minimum of deflection between fasteners. Hardened steel studs on about 3-in. centers can be screwed into the tank shell or driven by using a portable tool employing a blank cartridge for power. A "Drive-It" is such a tool, and presumably it can be rented if economic considerations do not permit its purchase. The gasketed plate then can be bolted down on the studs to correct the leaks.

If the above schemes are not applicable, the life of the tank can be prolonged by trowelling on a whole or partial liner, as required, of grout or hydraulic-setting refractory, such as "Super 3000". The mixture should be spread over chicken wire or expanded metal for reinforcing, held in place by means of 1/4- or 3/16-in. self-tapping metal screws turned into the metal shell.

Westbury, L. I., N. Y. WM. J. BURNS

Answer to No. 518

What Is Heat Loss From Cypress Water Tanks?

It's In The Book—Fogler

F. C. H. CAN find the information he wants in the Bureau of Standards' "Letter Circular 227," which he can obtain from the Bureau of Standards, Washington, D. C. A condensed table

continued on page 112

YOU'RE ALWAYS SURE of GREATER ECONOMY... with PREFERRED UNIT STEAM GENERATORS

With a Preferred "Packaged" heating unit you can be sure of—

1. A boiler designed for better performance, built beyond the codes, installed at lower cost.
2. A 25-year investment that pays for itself in one-fifth of its service life through more efficient steam production and greater fuel economy.
3. These Preferred quality features that make all the difference—

- Five Square Feet of Heating Surface per Boiler HP.
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Preferred Unit Steam Generators are available in sizes from 20 to 600 B.H.P. and pressures from 15 to 250 psi, to burn oil or gas or in combination.

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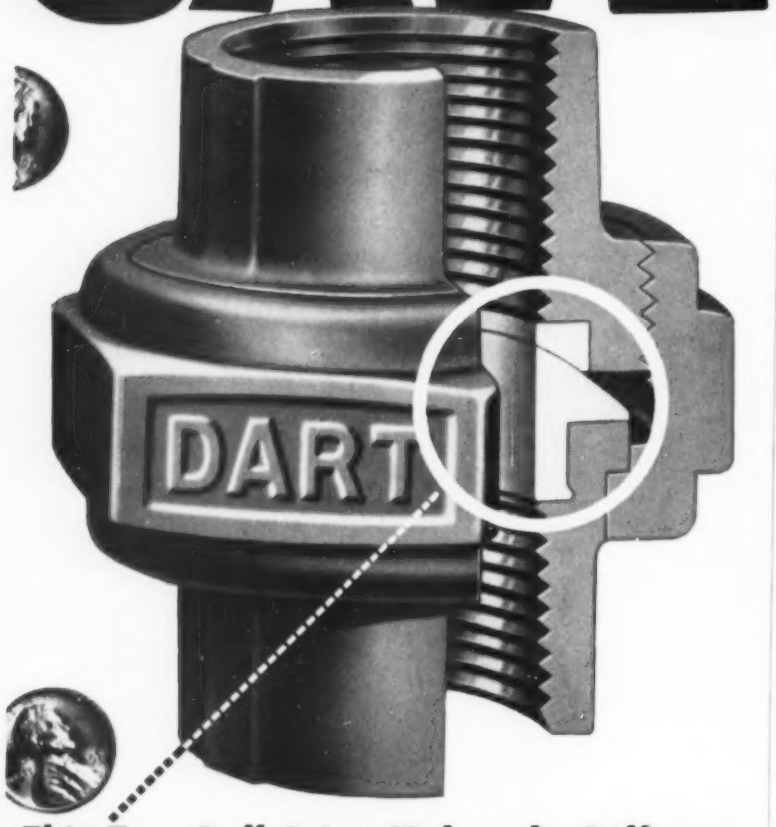
Dart Unions SAVE



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Darts save money because they can be used over and over again. One reasonable cost — many lives!

QUICK FACTS

- Leakproof because precision-machined to a true ball joint and spherically ground
- Bronze alloy seats are extra wide, resist pitting and corrosion
- Shoulders are heavy — take severe wrenching easily
- Practically indestructible Nut and Body... of air-refined, high-test malleable iron

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Questions and Answers

continued from page 111

from this letter appears in the "Handbook of Chemistry and Physics."

This table gives the internal thermal conductivity of various substances. That given for cypress wood is listed as 0.67 Btu per hr per sq ft, with a temperature gradient of 1 deg F per inch of thickness.

Acme, N. C. SAM J. FOGLER

Calculate Loss By Heat Input Method—Cooper

AS THE PRIMARY consideration seems to be the quantity of heat lost from these water tanks, and since the conductivity of cypress may vary considerably with age and wind velocity, I would suggest the following:

1. Fill tank with 150 F water just before a period when no water will be drawn from tank.
2. Set up a recorder to record tank temperature drop *and* outdoor temperature.
3. Estimate wind velocity or check with your local weather station on wind velocity during test period.
4. Correlate test data and arrive at a heat loss per sq ft of tank area.

An alternate method would be to set a thermostatic valve controller at some higher temperature than any possible outdoors during the test period. Record outdoor temperature and secure wind velocity as outlined above. By measuring the quantity of steam condensate, a fairly reliable figure of heat loss will be obtained for the specific installation.

Alliance, Ohio L. H. COOPER

Answer to No. 519

How Can He Prevent Corrosion In This Steel Stack?

Line Breeching and Stack or Use Auxiliary Burners—Wayne

BECAUSE HOGGED fuel has a high moisture content, it is suggested W. A. make a flue gas analysis and measure the stack gas temperature. If the gas temperature is below the dew-point, condensation of water vapor will occur and cause corrosion. Average dew-point temperature when burning a hogged fuel is 120 F.

One possible way to eliminate corrosion of the breeching and stack is to line them with Gunite or other refractory having similar properties. The cost of the undertaking depends upon the area and length of the breeching and stack and, since these dimensions have not been given, an accurate estimate cannot be made.

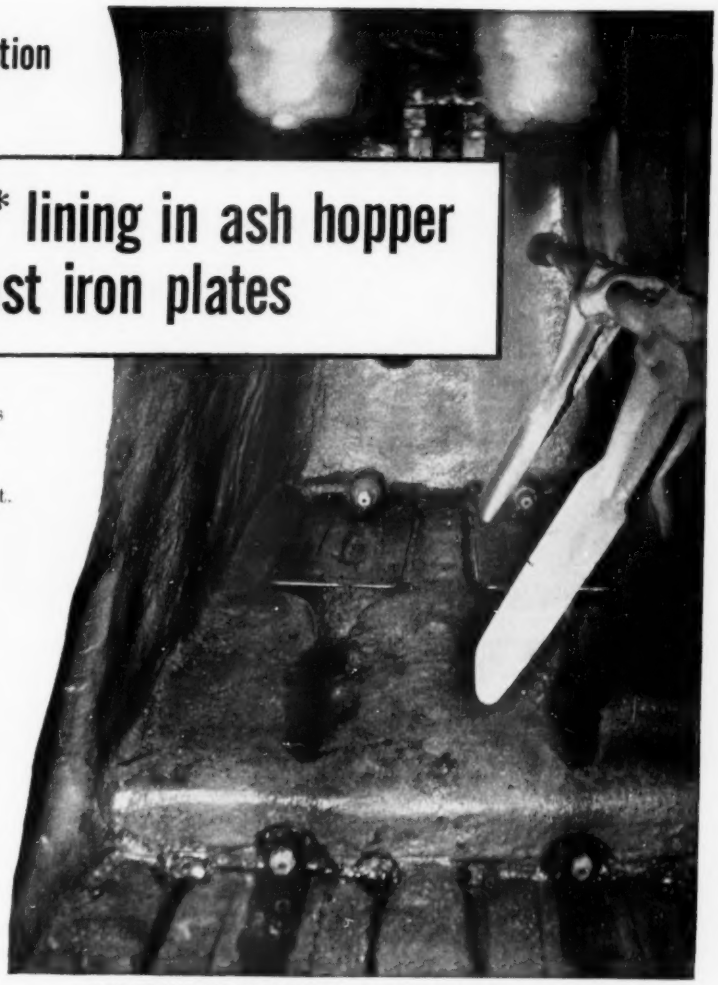
An alternate remedy is to fire the furnace with an auxiliary fuel, such as oil or gas, which will increase the combustion *continued on page 114*

Westinghouse Electric Corporation finds that . . .

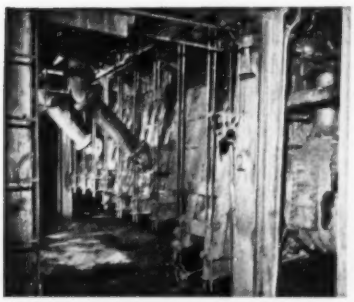
Low-cost LUMNITE* lining in ash hopper outlasts cast iron plates

Instead of replacing cast iron plates on this ash hopper, Westinghouse engineers simply specified a 2" lining of Heat and Corrosion-Resistant Concrete made with Lumnite cement. They've found it does a job fast . . . costs *far less* than new plates . . . and lasts much longer. In fact, they're so well pleased with Lumnite they now use it to line all their ash hoppers.

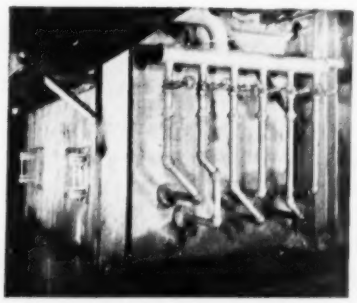
Does their experience with Lumnite cement suggest profitable uses to you? It's proved to be a better way to line stacks, breechings and flues . . . make coal bunkers, ash pits . . . cast door linings, water wall studding and baffles, and make many fast repairs. Concrete made with Lumnite calcium-aluminate cement reaches service strength within 24 hours. With appropriate aggregate it withstands heat of 2600°F. or more, and it's highly resistant to abrasion, corrosion and thermal shock.



THIS GIANT ASH HOPPER at the East Pittsburgh, Pa., power plant of Westinghouse got its durable lining of Lumnite concrete in a hurry. Lining was simply shot on with a cement gun.



CAST IRON PLATES on this ash pit were a major maintenance item—until Westinghouse used Lumnite concrete linings as in top photo.



LININGS made with Lumnite proved so successful, Westinghouse engineers specified Lumnite for this all-concrete ash hopper at the Trafford, Pa., Power Plant.

FOR CONVENIENCE in making Refractory and Insulating Concrete, you may prefer to buy prepared Castables. These packaged mixtures of Lumnite and selected aggregates are tailor-made to meet your specific temperature and *insulation* requirements. Add only water. They are made by refractory manufacturers and sold through their dealers.

For complimentary booklet on the many uses of time- and-money-saving Lumnite write: Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

*"*LUMNITE" *is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

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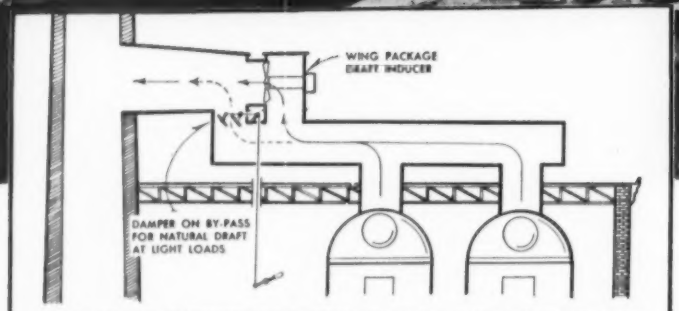
The WING Package DRAFT INDUCER



WING PACKAGE POWER PLANT DRAFT INDUCER at WELCH GRAPE JUICE COMPANY'S PLANT AT WESTFIELD, N.Y. SERVES TWO 20,000 lb./hr. BOILERS. NOTE (A) INDIVIDUAL CONNECTION FROM EACH BOILER (B) BY-PASS WITH DAMPER CONTROLLED FROM BOILER ROOM, PERMITTING NATURAL DRAFT AT LOW LOADS (C) RELATIVE LIGHT WEIGHT AND COMPACT PACKAGE DESIGN PERMITS SUPPORT ENTIRELY ON COMMON BREECHING.

The WING Package DRAFT INDUCER is unique in that the motor (or turbine) and fan is designed as one complete removable unit, making installation easier and being easily removed, facilitates inspection and maintenance. Other advantages are:

1. Big savings in space requirements
2. Permits fewer and lighter structural supports
3. Eliminates field line-up problems
4. Eliminates water cooling
5. Only two support bearings
6. Wide flexibility in gas outlets
7. Saves on investment and maintenance
8. Low load ratings on natural draft because of ample free gas travel area

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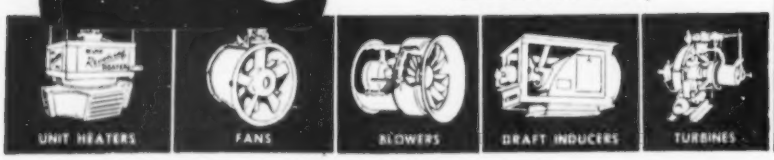

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Questions and Answers

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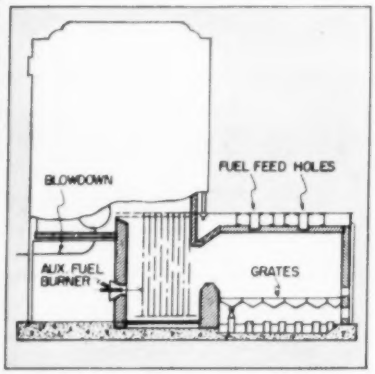

Typical dutch-oven furnace with horizontal grates for burning hogged fuel. Auxiliary oil or gas burner raises the flue gas above the dew-point

rate and elevate the temperature above the dew-point.

Cost of auxiliary fuel burning equipment varies with the boiler size as well as the type and size of burners. The cost would include the necessary piping, pumps and heaters if oil is used, or the pressure regulator and piping from the supply main if gas is used. The illustration shows a typical dutch-oven furnace designed to burn hogged fuel on horizontal grates and including auxiliary fuel burners.

Because of the lack of basic data required for the solution of this problem, it is difficult to make sound recommendations; therefore, the following procedure is recommended:

1. Make flue gas analysis.
2. From the analysis, determine the dew-point.
3. Take gas temperatures leaving the furnace and in the breeching and stack at various locations to permit plotting a temperature gradient.
4. If the gas temperatures are below the dew-point, obtain prices for:
   a. Lining the breeching and stack with Gunite.
   b. Installing equipment to permit burning auxiliary fuels to keep temperatures above dew-point.
5. If a dutch-oven furnace is not presently installed, obtain quotations for modifying the present design, if possible, and compare with the prices determined in 4-a and 4-b to ascertain if the better cost figure is justified by a further comparison with current maintenance expenses.

Brooklyn, N. Y. H. B. WAYNE

Readers submitting questions to Q and A should feel free to communicate all data necessary to the solution of their problems. Names are never used and POWER ENGINEERING acts as intermediary between those submitting questions and whose who answer them. Answers sent in to Q and A are paid for by POWER ENGINEERING and are made available at no cost to the questioner. Share your experience and/or your problems with other power engineers.

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H-T Water

continued from page 86

this cooler. Aside from motor and blower lubrication and seasonal cleaning, these units should require little or no maintenance or pad replacement for years at a time.

Cost Comparisons

Actual cost figures prepared by Paul Hardeman Inc., mechanical contractor on this project, for the high-temperature water system as designed, versus a comparable steam system, show an actual initial cost differential in favor of high-temperature water. The figures, in part, are included herewith:

LABOR — Distribution piping	20% less
LABOR — Piping within buildings	30% less
MATERIALS & EQUIPMENT	13% less
MAINTENANCE	60% less

Design for construction at the Marine Corps Training Center, Twentynine Palms, Calif., is under authorization of the Bureau of Yards and Docks, Navy Department, Washington, D. C. The Chief of Bureau is the Contracting Officer. However, by delegated authority, Capt. A. I. Flaherty, CEC, USN, the Public Works Officer of the Eleventh Naval District, San Diego, California, supervised design and construction and executed the formal contracts. Commander W. M. Enger, CEC, USN, functioned as the Resident Officer in Charge of Construction at the site.

Gas Turbine

continued from page 78

turbine passenger locomotive to be operated in the United States. This is an eight-axle, single unit locomotive, approximately 78 ft long, weighing 247 tons, powered by two 2,000-hp gas turbines, mounted side by side, with an electric transmission.

Someone has very aptly called the gas turbine locomotive "The Thrifty Glutton" when comparing it with the diesel locomotive. This phrase "The Thrifty Glutton" explains the economics of the gas turbine locomotive as compared to a diesel locomotive. For a given horsepower, the gas turbine gulps down about twice as much fuel as a diesel locomotive. But the railroad's fuel bill will be less with the gas turbine because it will utilize cheaper fuel. The gas turbine will use residual fuel which will cost 40 to 50 per cent as much per gallon as the diesel fuel now used. In addition the lubricating oil cost, now about 5 per cent of the total fuel cost on the diesel, will be negligible (a fraction of one per cent) with the gas turbine.

The fact that the gas turbine locomotive can develop the same horse-

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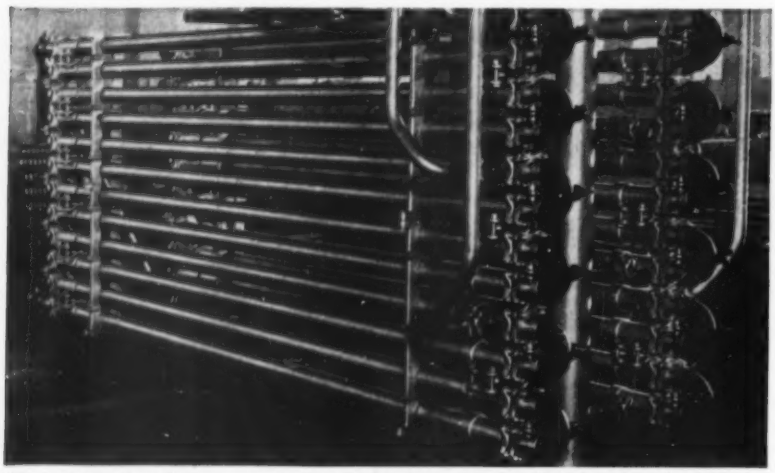

Ammonia type Beer Chiller—outer 3" pipes of steel; inner 2" Duplex Tubing with steel over copper. Beer is circulated through copper circuit. Courtesy The Vilter Manufacturing Co., Milwaukee, Wis.

Copper and its Alloys Increase Service Life of Refrigeration Systems

Mechanical refrigeration has grown very rapidly and has deeply penetrated industrial, processing, chemical, refining and domestic fields.

Since refrigeration systems involve many miles of tubing which must handle corrosive liquids, gases, or cooling waters, the selection of tube alloys capable of standing up under severe service conditions is one of the most fundamental problems confronting the engineer. In this field copper-base alloys are predominantly used because they have proven very satisfactory.

Freon and Methyl Chloride Refrigerants

Where refrigerants such as Freon or methyl chloride are used, Copper, Red Brass, Admiralty, Aluminum Brass, Aluminum Bronze and the Cupro Nickel alloys are corrosion resistant and give long life. The selection of the proper alloy depends upon the cooling water, brine, or product.

Ammonia Refrigeration

The good corrosion resistance of steels to ammonia, both gaseous and liquid, explains their wide use in the construction of equipment handling ammonia. However, steel tubes and pipes are subject to corrosion from brine, sea water or fresh water. This shortcoming can easily be overcome through the use of Duplex Tubing, consisting of copper or copper-base alloy to the water side and steel to the ammonia side. This combination is finding wide application not only for ammonia refrigeration, but also for equipment producing ammonia and its compounds.

The most popular combinations are low carbon steel with Copper, Admiralty, or Red Brass for handling fresh water from rivers, lakes, ponds, and wells. Where sea water is used for cooling purposes, Cupro Nickel, Duronze IV (arsenical aluminum bronze), Aluminum Brass, and Admiralty are preferred because of their greater corrosion resistance.

Corrosion by Brine

In general, copper and its alloys stand up very satisfactorily handling cooling brines. Where general or localized corrosion occurs, it is usually due to the presence of other substances in the brine. For example, ammonia contamination may lead to corrosion cracking of stressed yellow brasses.

Corrosive Atmospheres

Where air is being cooled, the moisture in the air is precipitated on the cool surface of the tubes. Such condensate may absorb corrosive gases and salts which are destructive to ferrous metals. Copper and its alloys generally withstand this type of corrosion very satisfactorily.

Where air instead of water is cooling the refrigerant, copper and its alloys give excellent service.

Circulating Fresh Water

For fresh water, Copper is very widely used. Admiralty and Red Brass are also in common use, the Admiralty being preferred where sulfides are present in the cooling water.

Circulating Sea Water

For sea water at velocities of 5 to 6 ft. per second, Arsenical Admiralty stands up well. Where the velocities exceed this speed, impingement corrosion may be encountered in Admiralty tubing. Under these conditions Aluminum Brass, Cupro Nickel or Duronze IV should be used because of their superior resistance to impingement.

Product Corrosion

For handling beverages, chemicals, liquids, or gases, the selection of the most suitable metal depends upon the nature of the product handled. For many applications, copper and its alloys are very satisfactory. For special cases involving the handling of liquids or gases corrosive to copper, or where product contamination by traces of copper is undesirable, Duplex Tubing consisting of Aluminum, Low Carbon Steel, Stainless, etc., combined with Copper and its alloys often give excellent service.

Laboratory Service

Bridgeport corrosion metallurgists have been helpful in recommending Duplex Tubing combinations which have led to improved operating efficiencies. Not only has tube life been greatly extended but lower maintenance has resulted. Contact your nearest Bridgeport office for help on your metal problems and for your tube requirements. (1338)

For more data circle 559 on Post Card

power in two-thirds the weight and one-half the length of a comparable diesel makes it even more attractive to the railroads. Of course maintenance on the rotating type of plant such as the gas turbine, is expected to be less than on a reciprocating plant, such as the diesel engine.

Mechanical Drive for Process

The gas turbine power plant as a driver for pumps, blowers, compressors, etc. for general process applications is now limited to a very few frame sizes. The use of gas turbines in this category will increase not only because of simplicity of the gas turbine plant but also because of another characteristic, flexibility, which is difficult to evaluate economically. Flexibility refers here to the following:

1. Ability to install plant without increase in existing boiler capacity.
2. Ability to use exhaust gas to generate low pressure steam in waste heat boiler, feedwater heating or directly for process purposes.
3. Small size and low weight of plant permits portable or semi-mobile type of installation.
4. Ability of plant to be independent of all outside facilities, other than fuel, once in operation.

Figure 6 shows an 1,800 hp, simple open cycle, gas turbine power plant driving two centrifugal air compressors in tandem. This illustrates the point of flexibility very well. This is a trailer-mounted, mobile type of plant (rubber-tired trailer in background). The plant receives starting power for electric motor and ignition from a skid-mounted diesel generator unit. Power for all auxiliary motors is supplied by an attached 60-kw generator, once plant is running. "Oil to air" radiator type lubricating oil coolers are used so no cooling water is required. The only external connection required while running is a distillate oil fuel line.

Summary

Table II shows the operating cycle diagram, plant designation, ratings available and the field of application where these plants seem particularly justified on an economic basis at the present time. As more operating experience is obtained and the reliability of the gas turbine power plant is demonstrated, other ratings and types of cycles will become available.

The gas turbine offers the greatest promise in improvement in efficiency of any heat engine developed today. Improvements will come about thus:

1. Metallurgical developments to provide materials to withstand higher operating temperatures.
2. Development of improved and practical cooling means to allow higher operating temperatures with the materials now available.
3. Ability of gas turbines to burn a wider range of fuels including residual oil and possibly even coal.
4. Improvement in component efficiencies of the plant.

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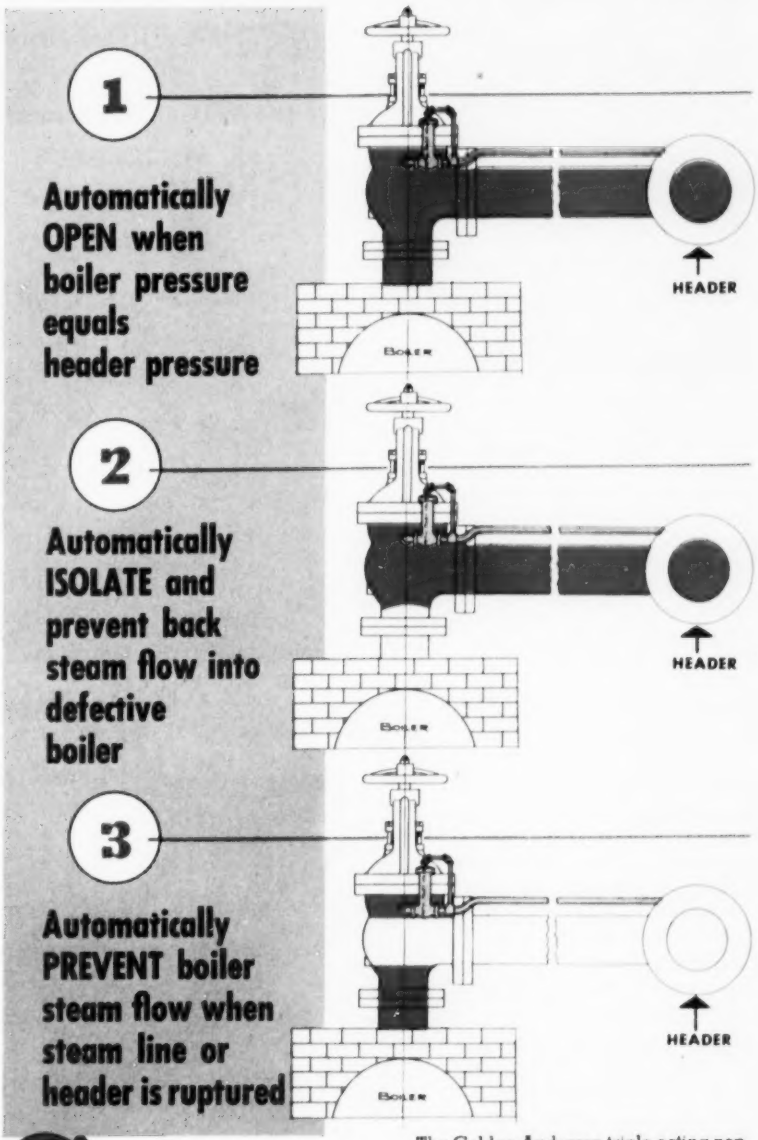
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Automatically OPEN when boiler pressure equals header pressure
HEADER
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OBITUARIES

David Moffat Myers

DAVID MOFFAT MYERS, consulting engineer, died at his home, 3 Cliff Way, Larchmont, N. Y., on January 20, 1954. He was 75 years old.

Mr. Myers was a prominent consulting engineer in New York for many years, and was a specialist on industrial power supply. He was born

in Owasco, N. Y. He attended Collegiate School, New York and then took the degree of Mechanical Engineering at Columbia in 1901.

Mr. Myers began his career as Mechanical Engineer U. S. Leather Co., 1901–6; was in private practice 1906–15; partner in the firm of Griggs and Myers 1915–25; later a member of the firm of Orrok, Myers and Shoudy, and then partner in the firm of Myers, Fuller and Addington. He was Consulting Engineer, Bureau of Yards and Docks U. S. Navy, and for the past eight years Consulting Engineer, New York Board of Water Supply. At the time of his death he was consultant with the firm of Seelye Stevenson Value & Knecht.

During World War I, Mr. Myers served as a volunteer with the U. S. Fuel Administration, being appointed Advisory Engineer and Chief of the Fuel Engineering Section which he organized.

Mr. Myers was a director of the Gramercy Boys Club of New York; the Larchmont Civic Association; a Fellow American Society of Mechanical Engineers, member American Association for the Advancement of Science; American Institute of Consulting Engineers; Society of Older Grads, Columbia University; director, Westchester Shore Humane Society; former Commodore, Horseshoe Yacht Club, member Columbia University Club; former member Cosmos Club of Washington, D. C. He was a member of the Dutch Reformed Church.

Mr. Myers was also an author and an inventor. Among his books were Factory Power Plants; The Power

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Plant; Cost Cutting for Industrial Power Plants; Reducing Industrial Power Costs; as well as many articles and papers for technical publications (including POWER ENGINEERING) and organizations. His inventions included furnaces for special fuels; the acquaknot speed indicator for boats; a sail slide guide; and the aeroknot indicator of velocity of the wind. He was also a talented amateur artist.

Dr. Karl B. McEachron

DR. KARL B. MCEACHRON, 64, General Electric Co. scientist who was internationally known for his pioneering work on man-made lightning and high voltage phenomena, died Jan. 24 in Pittsfield, Mass.

It was under Dr. McEachron's direction that a 10,000,000-volt artificial lightning generator was used to

produce the crashing bolts seen at the New York World's Fair. Continuing developments resulted in a new High Voltage Laboratory, opened at Pittsfield four years ago, where 15,000,000-volt peak voltages capable of sparking over a 50-foot gap are generated. His research in natural lightning included originating and supervising the first program of photographing lightning bolts striking the Empire State.

He was co-author, along with K. G. Patrick, of the book, "Playing With Lightning," published in 1940.

Dr. McEachron was honored many times for his achievements in the field of electrical engineering. In 1949 he received the Edison Medal, one of the highest honors in electrical research, from the American Institute of Electrical Engineers.

He was largely responsible for the development of a resistance material still used in lightning arresters and other applications. For this work he received in 1931 the Charles A. Coffin Award, highest G-E award.

A native of Hoosick Falls, N. Y., he was graduated from Ohio Northern University in 1913 with E.E and M.E. degrees. Following graduation he joined General Electric as a stu-

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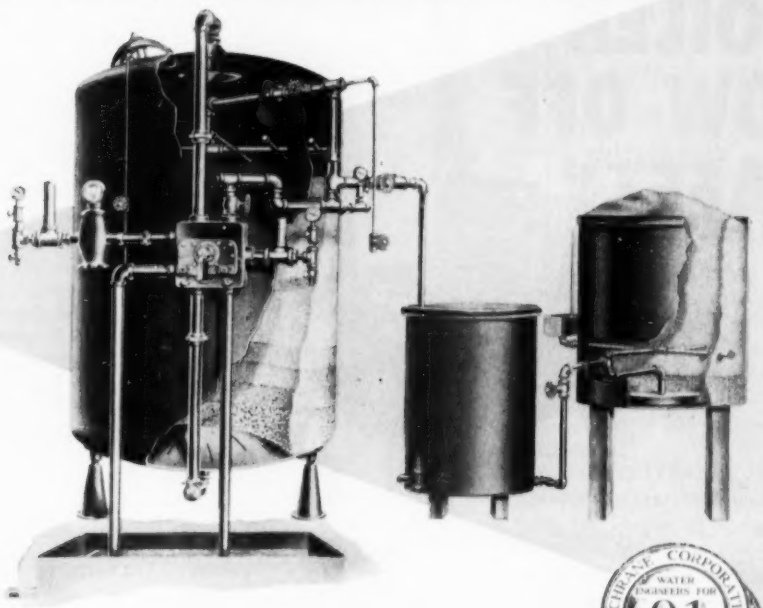

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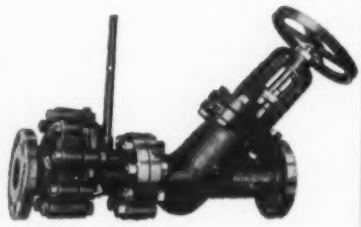

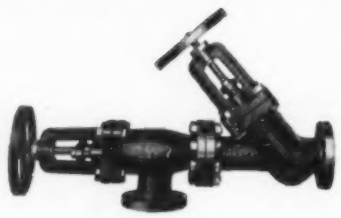

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dent engineer on the test course at Pittsfield. He returned to Ohio Northern in 1914 as an instructor in electrical engineering. In 1918 he was named as instructor in electrical engineering and a research associate at the Engineering Experiment Station at Purdue University where he received an M.S. degree.

Dr. McEachron returned to General Electric in 1922 to take charge of the research and development section of the Lightning Arrester Engineering Department at Pittsfield. He was appointed engineer in charge of the High Voltage Laboratory in 1933. After serving in several managerial positions, he became in 1952 manager of the Laboratory-Engineering Department, Transformer Division. In 1953 he was appointed consultant of professional employee relations and recruited young engineers throughout the country.

S. M. Rust

STIRLING MURRAY RUST, chairman of the board and a founder of The Rust Engineering Company, died at Homestead Hospital, Pittsburgh, Penna., after a short illness. He was 72 years old.

Mr. Rust was born at "Rockland," Loudoun County, near Leesburg, Va.

Going to Pittsburgh in 1898, he began work as a laborer for C. G.

Hussey & Co. He next worked as a blue-print boy with Jones & Laughlin Steel Co., and later with other steel companies in design, construction and operation of steel plants in Pittsburgh, and other cities.

In 1905 he joined with two brothers, Edmund Jennings Lee Rust and Ellsworth Marshall Rust, to form The Rust Engineering Company in Birmingham, Ala., which was at first a partnership. In 1913 Mr. Rust established a branch of the company in Pittsburgh.

In 1920 the firm was incorporated with headquarters in Pittsburgh, Mr. Rust becoming president. He served in that capacity until October 24, 1944, when he became chairman of the board and his son, S. M. Rust, Jr., succeeded as president.

NEW ENGINEERING BOOKS

Trane Air Conditioning Manual; size 11 by 8½ in.; 380 pp; illustrated; cloth bound. Published by the Trane Co., LaCrosse, Wisconsin. Price $5.00.

This second major revision of this useful manual presents a brand new addition in the chapter on fans and cuts. The new chapter alone costs one dollar. If a copy of the manual was purchased in a six-month period prior to the publication of the new edition, the buyer may get the new chapter at half price.

The basic principles of physics appear in the first chapter. These deal with heat and cold. The psychrometric properties of air are discussed in another chapter with special attention being given to the use of the chart.

Refrigeration, calculations for conditioned air supply, water for air conditioning, heat gains and comfort are other topics covered in the book.

A section in the back of the book is devoted to reference tables. Some of these pertain to the following: specific heat of substances; properties of saturated steam; weight of freon to be circulated per ton of refrigeration; tonnage capacities of liquid pipe lines and heat transfer coefficients.

★ ★ ★

Introductory Nuclear Physics, by David Holliday. First Edition; 558 pages; 5½ by 8½ in.; illustrated; cloth; published by John Wiley and Sons, Inc., 440 Fourth Ave., New York, N. Y.; 1950. Price $6.50.

This book expounds the philosophical aspects of nuclear physics besides integrating problems and modern points of view. In general, Professor Holliday discusses nuclear physics as it is today, the historical development having been largely ignored. While the book is designed as a textbook for a beginning graduate course in nuclear physics, as the author points out, by omitting material in fine print, it can also be used for an advanced undergraduate course.

An idea of the scope of the book may be had from the following chapter headings: 1 — Basic Nuclear Concepts; 2 — Alpha and Gamma Emission; 3 — Electrons in Disintegration Processes; 4 — Interaction of Charged Nuclear Radiation and Photons with Matter; 5 — Detection of Charged Particles and Photons; 6 — Neutrons — Production, Detection and Interaction with Matter; 7 — Nuclear Mass Numbers and Mass Abundances; 8 — Nuclear Forces; 9 — Charged Particle Accelerators; 10 — Nuclear Reaction; 11 — Nuclear Fission; 12 — Cosmic Rays; 13 — Nuclear Spin and Magnetism.

The subject is treated descriptively rather than from a rigorous mathematical standpoint. Abundant tables and key references to modern literature are included and there is a great abundance of illustrations.

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"THEY NEED MONEY, though. $5,000,000 is still less than 4 cents per American *per year*. Not enough. Not enough to find the answer *fast* enough—230,000 Americans are going to die of cancer *this year*, they say.

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WATER CONDITIONING

201 Handbook on Demineralizing — Bulletin 5800, 39 pp, on treating water by demineralizing, explains principle of ion exchange. Discusses applications of many anion and cation exchange materials; series of curves help estimate cost of operation. Describes design and operation of demineralizer systems, multi-stage systems and mixed bed units. Includes curves of water quality obtainable. Cochrane Corp.

202 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

203 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

204 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater makeup requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

205 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionisers. Illinois Water Treatment Co.

206 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. % Proportioneers, Inc. %

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207 **Water Conditioning Bulletin** — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition. Wright Chemical Corp.

208 **Water Treatment** — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

209 **Microbiological Control** — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

BOILERS, GENERATORS

210 **Shop-Assembled Boiler** — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions given. The Babcock & Wilcox Co.

211 **Improved Steam Generator** — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

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212 **Steam Generators** — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

213 **Packaged Boilers** — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000

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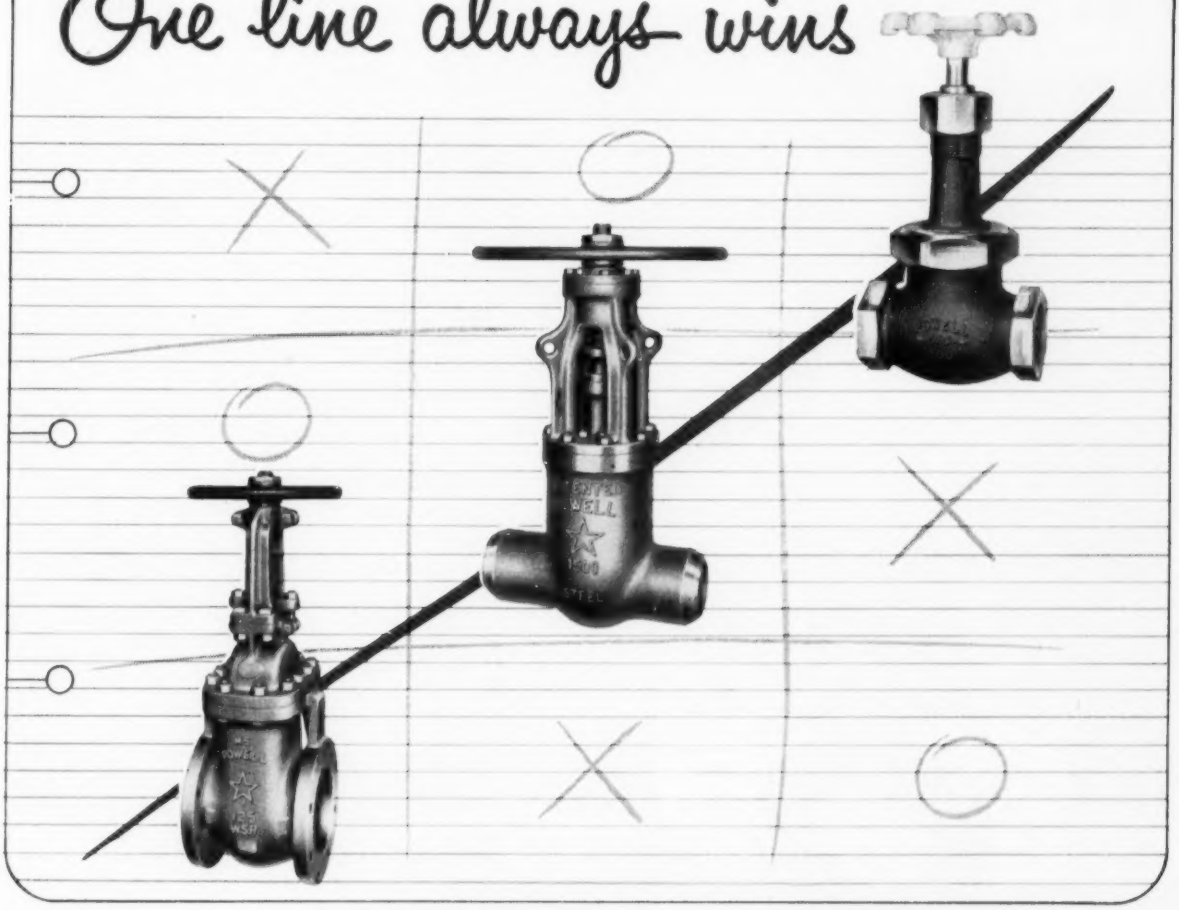

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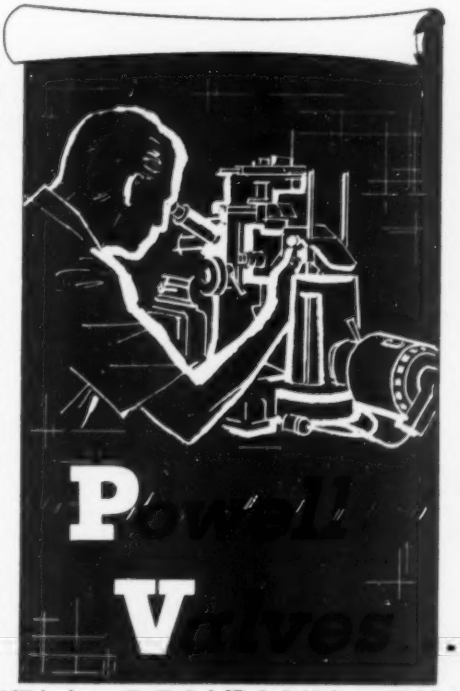

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to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

214 Scotch Marine Boilers — Bulletin 236 illustrates and describes a Scotch type of boiler on skids suggested for a wide range of applications. This boiler can be hand- or stoker-fired with coal or can use oil, gas or wood as fuel. Gives construction details, stresses versatility, other advantages. Includes test data and specifications. The James Leffel & Co.

215 Steam Boilers — Form AD-100 is an 8-pp catalog providing complete description of company's self-contained boiler, hot water or steam, for heating and processing. Includes design details, capacities, dimensions and application information on boilers ranging from 15 to 500 hp and 15 to 250 psi. Cleaver-Brooks Co.

BURNING EQUIPMENT

216 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Specifications included. The Engineer Co.

217 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

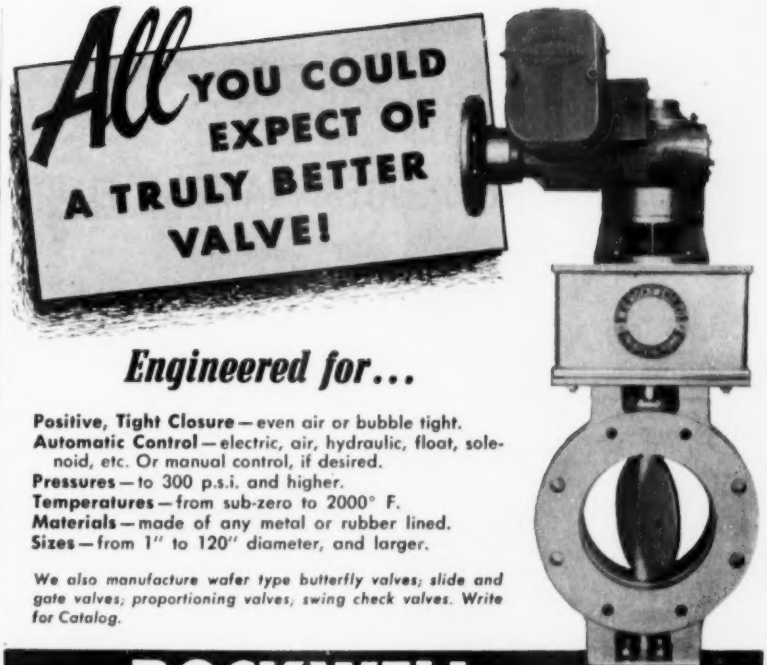
COAL, ASH HANDLING

218 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

219 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

220 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

221 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and



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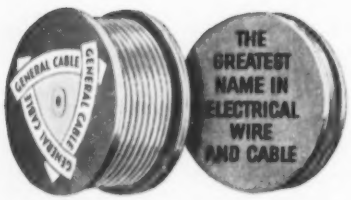

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accessories. Photos and line drawings show scale features. Richardson Scale Co.

222 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions are included. Beaumont Birch Co.

223 Fly Ash Elimination — This 30-pp booklet presents manufacturer's "Multiclone" equipment (described as small-tube type of cyclonic dust collectors using centrifugal force for separating dust from gas stream) as a highly successful and economical means of separating fly ash — not as a panacea for all cinder and fly ash problems. Also gives data on single and double hopper installations. Western Precipitation Corp.

FUEL OILS, LUBRICANTS

224 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

225 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

Postage-free cards for ordering catalogs are on pages 127-128. You may also use the cards to ask for further information on the advertised products

226 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

227 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

228 Lubrication of Chain Drives — Vol. 39, No. 8 of Lubrication offers a 10-pp discussion on chain drives and their lubrication. Covers types of chains, conditions affecting their lubrication, choice of lubricants. Includes table showing lubricant recommendations for chain drives. Generously illustrated with photos

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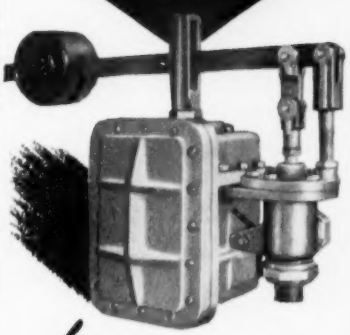

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and sketches showing chain arrangements, methods of lubrication. The Texas Co.

229 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

TUBING AND ACCESSORIES

230 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

231 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are given. Scovill Mfg. Co.

232 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

233 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

234 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

235 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

HEAT EXCHANGING, COOLING

236 Heat Exchangers — The advantages of film-type heat exchangers in the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

237 Finned Tube Heat Exchanger — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Griscom-Russell Co.

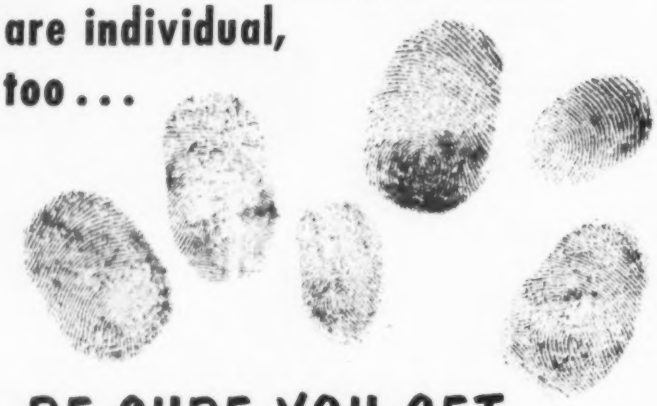
238 Heat Exchanger — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

239 Heat Exchangers, Storage Heaters — Sixteen-pp Catalog 5 covers more than a dozen types of hot water storage heaters and heat exchangers, including horizontal and vertical hot water storage heaters, instantaneous water heaters, converters, condensate coolers. Tables assist in selecting correct equipment for given operating conditions and typical examples demonstrate use of the tables. Patterson-Kelley Co., Inc.

VALVES, TRAPS, PIPING AND ACCESSORIES

240 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of

Water conditioning problems are individual, too . . .



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With the Wright Water Conditioning Service, your water conditioning is treated as an individual problem from start to finish. Without obligation on your part, Wright will make a scientific laboratory analysis of your problem, then submit a written proposal for its solution. After you adopt our recommendation, Wright will maintain a constant field and laboratory check to insure proper performance.

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tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

241 **Safety Valve Engineering Data** — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

242 **For Quick Valve Selection** — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and indexed, includes pressure-temperature chart. The Ohio Injector Co.

243 **General Service Valves** — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

244 **Easily Operated Valve** — Bulletin W-8 describes design and construction of company's Flowtrol suggested as a replacement for gate valves that require frequent manual opening and closing, or in place of diaphragm valves. Stresses air and water cushioning to prevent hammer or shock, easy installation, other features. Golden-Anderson Valve Specialty Co.

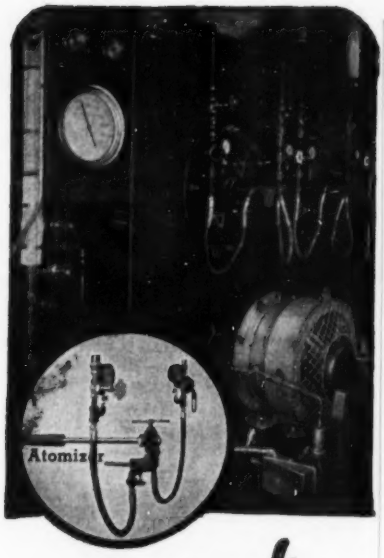
245 **Butterfly Valves** — Construction details, engineering and application data on butterfly valves are provided in three illustrated bulletins. Eight-pp Bulletin 557 covers those of standard heavy-duty construction; Bulletin 558, 8 pp, those of standard medium-duty construction; and Bulletin 559, rubber-lined butterfly valves. W. S. Rockwell Co.

246 **Cast Steel Valves** — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

247 **Lubricated Plug Valves** — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

248 **To Get at Those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

249 **For Precise Control** — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manuals and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.



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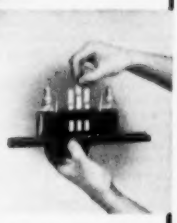

B. Add reagent to middle tube only.

C. Place color standard on base, move across until colors match and...

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List of Users

The types of industries listed are all repeat users of **Tru-Lay Push-Pull Controls.** Experimental applications are not shown.

Agricultural Equipment
Air Conditioning Equipment
Aircraft & Parts Automobiles
Bakery Equipment Boats & Ships
Bottling Machinery
Brewing & Distilling Equipment
Business Machines
Buses & Motor Trucks
Candy Making Machinery
Canning Machinery
Ceramics Machinery
Chemical Processing Machinery
Coal Mining Machinery
Coin Operated Machines
Construction Machinery
Dairy Products Machinery
Dental & Surgical Equipment
Die Casting Machinery Diesel Engines
Drinking Water Coolers
Electrical Appliances
Electrical Generating Equipment
Electrical Machinery
Electrical Transmitting Equipment
Electronic Equipment
Elevator Control Panels
Fire Protection Equipment
Food Processing Equipment
Forging Machinery
Foundry Equipment
Gas & Oil Production (Test Stands)
Glass Making Machinery
Grain Processing Equipment
Hat Machinery Heating Equipment
Hydraulic & Pneumatic Equipment
Ice Cream Making Machinery
Laundry & Dry Cleaning Equipment
Leather Working Machinery
Lumber & Saw Mill Machinery
Marine Equipment
Materials Handling Equipment
Metal Mining Machinery
Metal Working Machinery Machine Tools
Military & Naval Equipment
Motorcycles & Bicycles
Nuclear Science Equipment
Oil Refinery Equipment Ordnance
Packaging Machinery
Paint Making Machinery
Paper Making Machinery
Photo Equipment (manufacture)
Plastics Fabricating Machinery
Plastics Producing Machinery
Power Plant Equipment
Printing & Binding Machinery
Quarrying Machinery
Radio & Television (manufacture)
Railroad Equipment
Road Building & Maintenance Equipment
Rubber Processing Equipment
Safety Locks on Fuse Panels
Sanitation Plumbing (Floor Valves)
Shoe Machinery Steel Mill Machinery
Telephone & Telegraph Machinery
Textile Machinery
Waterworks Equipment
Welding Equipment
Wire Making Machinery
Woodworking Equipment
X-Ray Machines

Whether your interest is in a single application of this versatile

PUSH-PULL CONTROL

or in its inclusion as a component of the product you manufacture, we would welcome your request for our **DATA FILE** for your further study.

Because TRU-LAY PUSH-PULL CONTROLS are "SOLID as a rod but *FLEXIBLE* as a wire rope" their use has simplified the design and improved the operation of literally hundreds of products as indicated in the accompanying list of repeat users.

These fine controls are designed, and painstakingly built, to have the qualities of ACCURACY, HIGH LOAD CAPACITY, FREEDOM FROM TROUBLE, LONG LIFE, FLEXIBILITY . . . they are frequently and successfully used in conjunction with electrical, hydraulic and air controls . . . they are thoroughly effective under almost any operating condition.

Here are some of the jobs they handle well . . . HOT jobs on jets and industrial furnaces . . . COLD jobs down to –70°F. . . . WET jobs in food processing and marine applications . . . DIRTY jobs in cement mills and coal mines . . . CORROSIVE jobs in chemical processing . . . HEAVY, TOUGH jobs on construction machinery . . . LIGHT DUTY jobs on business machines, drinking water coolers . . . REMOTE jobs 150 feet or more from control point . . . they DAMPEN VIBRATION to protect delicate instruments . . . and LUBRICATION of the inner, working member is taken care of *for life* during assembly.

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250 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

251 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

252 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

253 Improved Pipe Hanger — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. Graphs for selecting proper hangers, tables of dimensions, plus erection are given. National Valve & Mfg. Co.

254 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

255 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

256 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring

257 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

258 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam

traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications, and data covering the selection. W. H. Nicholson & Co.

ELECTRICAL

259 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

260 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance is provided. Westinghouse Electric Corp.

261 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

262 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

263 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

264 The Answers on Wiring — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

PACKINGS, GASKETS, SEALS

265 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular

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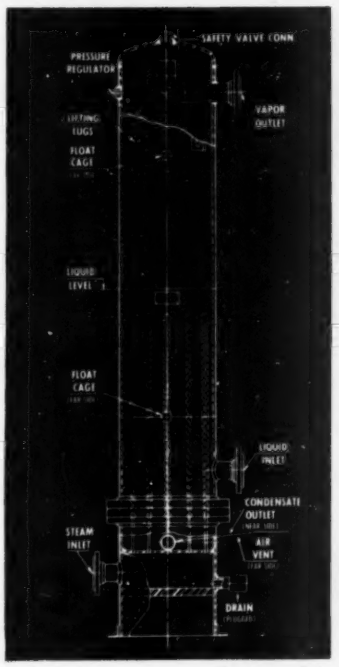

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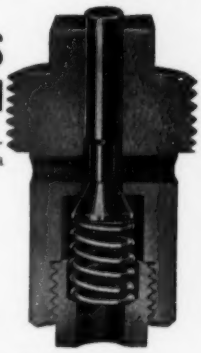

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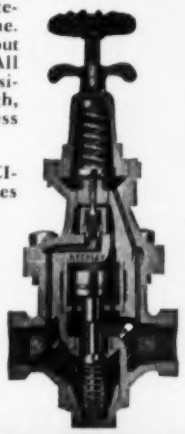

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packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for many applications. Packing Div., Raybestos-Manhattan, Inc.

266 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

267 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. Illustrated. Includes construction information, sizes. Johns-Manville.

268 Long Wearing Piston Packing — Form 4502, 8 pp, presents composition cups for packing pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature and pressure data, sizes. Darling Valve & Mfg. Co.

INSTRUMENTS AND CONTROLS

269 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

270 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls. Republic Flow Meters Co.

271 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Description of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

272 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

273 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

274 Oxygen Analyzers, Recorders — Bulletin 105, 6 pp, describes and pictures oxygen analyzers and recorders giving their general characteristics, and features, explaining their paramagnetic principle of operation, and discussing their applications. Covers both deflection and null type analyzers; discusses sampling requirements. Arnold O. Beckman, Inc.

275 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

276 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

277 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-

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Continuous records of the oxygen dissolved in boiler feed water and of the hydrogen entrained in steam, indicate when corrective measures are necessary to prevent otherwise unsuspected and costly corrosion. Cambridge Analyzers measure and record dissolved oxygen directly. The hydrogen in the steam is measured and indicates the quantity of oxygen set free by dissociation. Cambridge Instruments are available for continuously recording either O_2 or H_2 separately, or O_2 and H_2 simultaneously.

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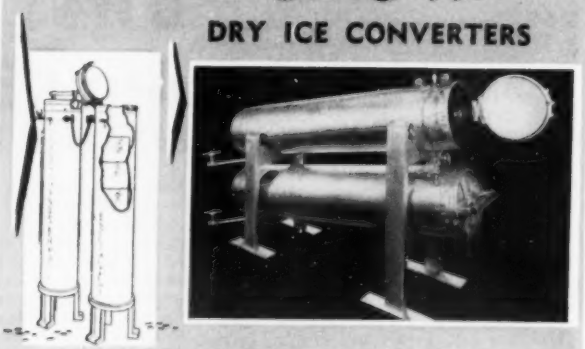

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with Chain Guide

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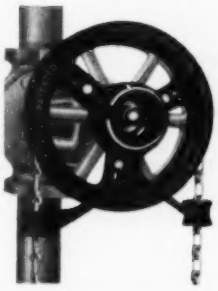
Only four simple, quickly-assembled parts installed and operating in only a few minutes, Babbitt Adjustable Sprocket Rim with Chain Guide —



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Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

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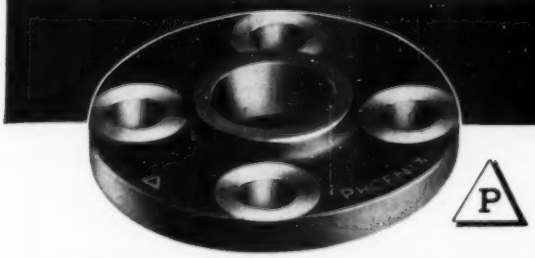

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- **END SCALE FORMATION**
- **REDUCE BLOW-DOWN AND MAKE-UP**
- **CUT DOWN COSTLY BOILER REPAIRS**

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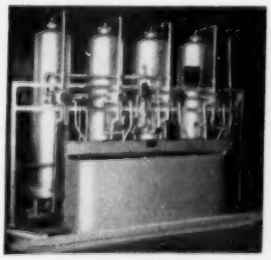

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1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

278 Boiler Control — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

279 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

280 Pneumatic Valve Operator — This 8-pp bulletin explains operating principles and outstanding features of the Rotomotor positioning operator for throttling control service. Tells how this heavy duty, all-pneumatic operator is designed to combine safety and economy of air operation with the power of a gear driven screw stem. Conoflow Corp.

REFRACTORIES, INSULATION

281 Refractories for Heat, Power — Compiled to help power engineers solve refractory problems and get greater operating efficiency from their boilers, this booklet provides 32 pp of practical information on company's Crystolon refractories. Properties and characteristics of these silicon carbide products are given and separate chapters cover those for air-cooled, solid wall and water tube protection, and for repairs. Norton Co.

283 Heat Insulation Data — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp.

PUMPS, PUMPING

284 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

285 Controlled Volume Pumps — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suited for use with some 170 industrial fluids. Milton Roy Co.

286 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

OTHER EQUIPMENT

287 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings. Elliott Co.

288 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

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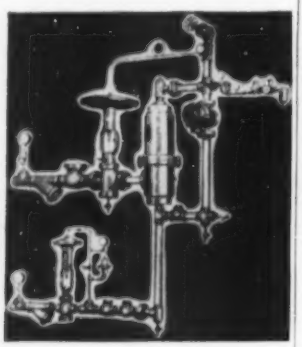

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Postage-free cards for ordering these catalogs are provided on pages 127-128

292 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

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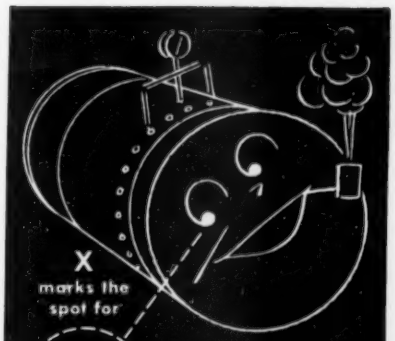

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pressures to 1500 psig

DE LAVAL CPO PUMPS
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heads to 200 feet

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DE LAVAL STEAM TURBINE COMPANY
816 Nottingham Way, Trenton 2, New Jersey

DL-236

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CONTROL OF EXCESS AIR BY CITIES SERVICE HEAT PROVER CAN REDUCE HEAT LOSSES AT CEMENT PLANTS! In cement-kilns, air must be controlled to the precise quantity that will just completely burn the fuel. Any excess of air above this amount carries waste heat out of the kiln. THE HEAT PROVER ENABLES THE OPERATOR TO SEE WHEN THE RIGHT AMOUNT OF AIR IS ENTERING THE KILN.

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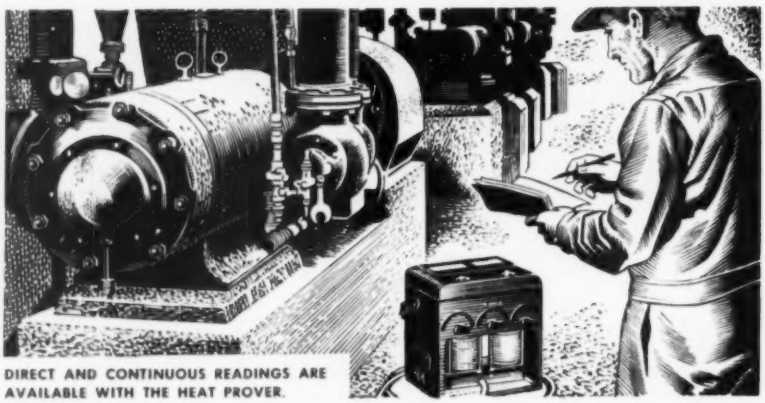

DIRECT AND CONTINUOUS READINGS ARE AVAILABLE WITH THE HEAT PROVER.

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...or do you need *special* steel valves?

CHAPMAN CAST STEEL VALVES are made in gate, globe, swing and tilting disc check types . . . to handle the most severe high-pressure, high-temperature services. These valves are made to ASA and API ratings in all sizes. And on the special side, Chapman has everything needed to develop alloys and designs for *any* requirement. Do *you* have Catalog 20?

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS

YEAR BY YEAR, CHAPMAN WRITES NEW CHAPTERS IN METALLURGY AND FLOW-CONTROL

For more data circle 592 on Post Card

Preventing high-volt leaks with PERMUTIT demineralized water

THE 75' diameter atomic accelerator shown below has five times more power than any other. Its 2200 ton electromagnet quickly whips particles three million times 'round the racetrack to an energy approaching 3 billion electron volts.

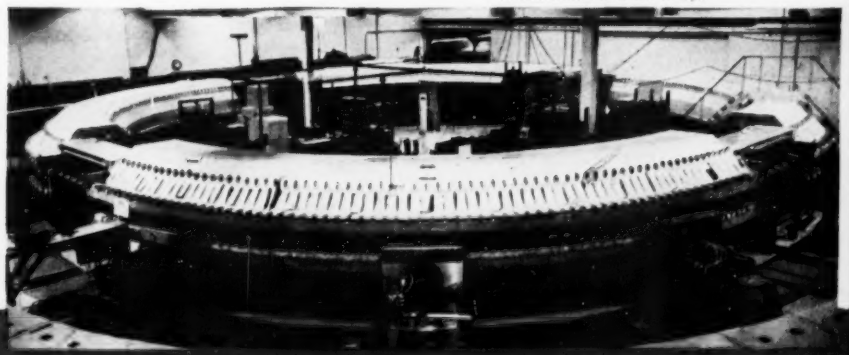
Packing all this power into a reasonable-size unit was a problem. Size ruled out air cooling. So the bus-bar magnet coil was made for circulating cooling water.

But at 3,000 volts, the dissolved minerals in *untreated* cooling water could conduct electricity, causing appreciable leakage to grounded piping. A means had to be found for producing water purer than conventional distilled water—at low cost.

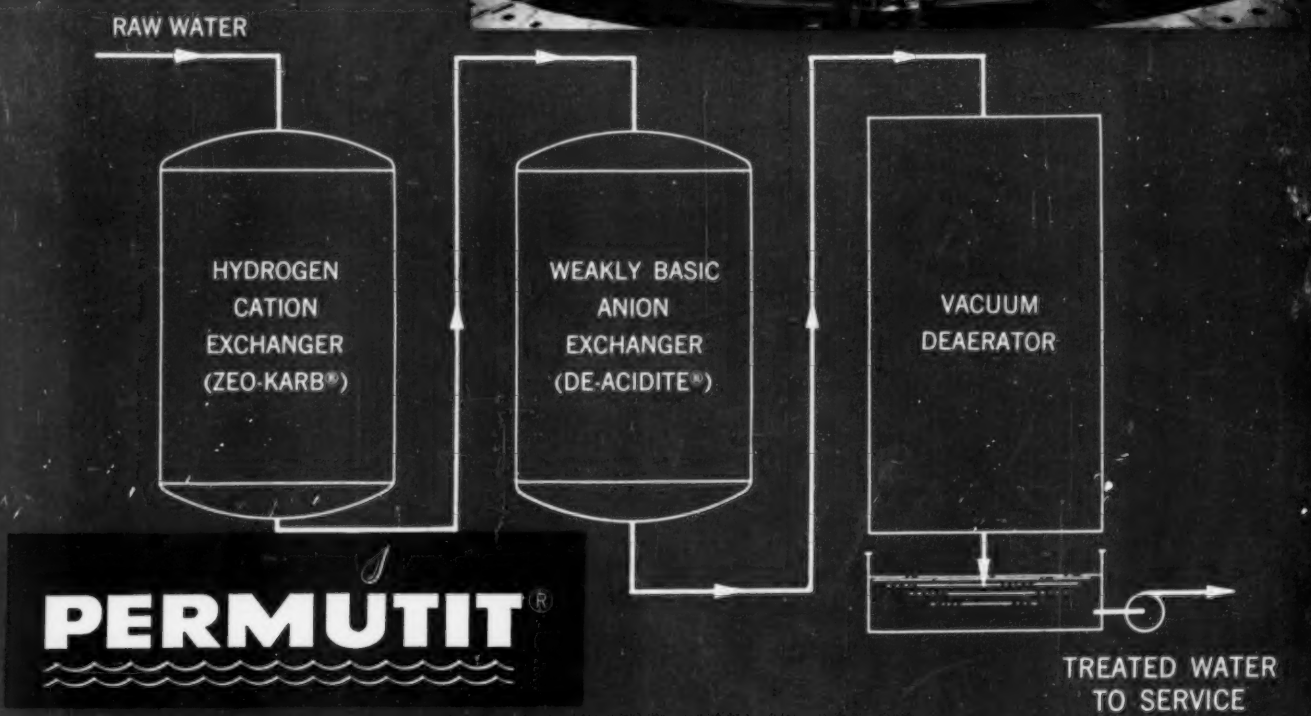
A Permutit Demineralizer was selected *(see diagram)*. Cooling water recirculated through this ion exchange unit approaches the very low conductivity of pure water, hence it has been completely effective in removing dissolved solids.

Find out how Permutit can solve your water problems. Write to THE PERMUTIT COMPANY, Dept. PE-3, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

The giant Cosmotron at Brookhaven National Laboratory.



Permutit two-step Demineralizer with Vacuum Deaerator. Troublesome cation impurities are removed in the first step, remaining minerals in the second, oxygen and CO_2 in the final.



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